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POST OFFICE

telecommunications

JOURNAL

ONE SHILLING AND SIXPENCE

WINTER 1964

The M.E.L. range of Broadcasting Link Equipment contains systems capable of relaying or repeating any type of broadcast signal. There are V.H.F. music links suitable for a fixed link service between studios and broadcast transmitter, and as O.B. links.

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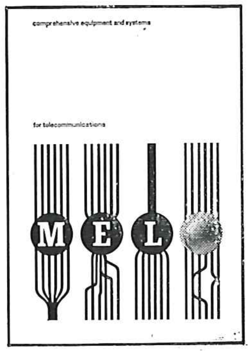
Needless to say, we also produce a comprehesive range of ancillary equipment, including radio terminals for telephony, tone modulators, line amplifers, aerial matching units and transformers, and variable and crystal oscillators.



This interesting, illustrated booklet will tell you much more about our activities in the field of telecommunications.
Broadcast Link Equipment, for instance, is fully described on page 6. Make sure of receiving your copy now by dropping us a line today.

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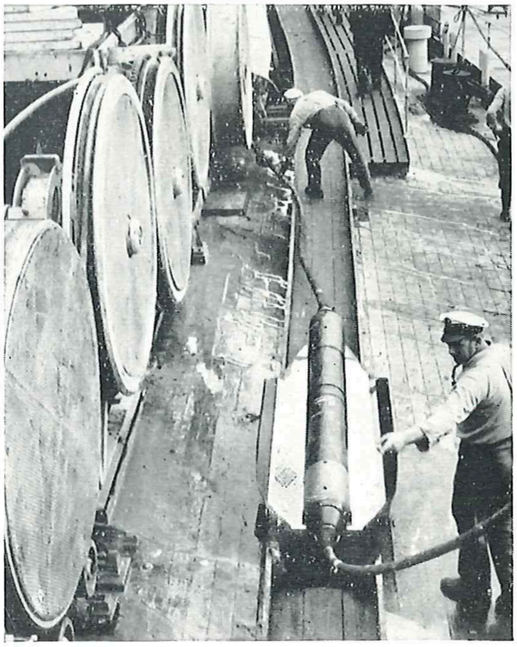

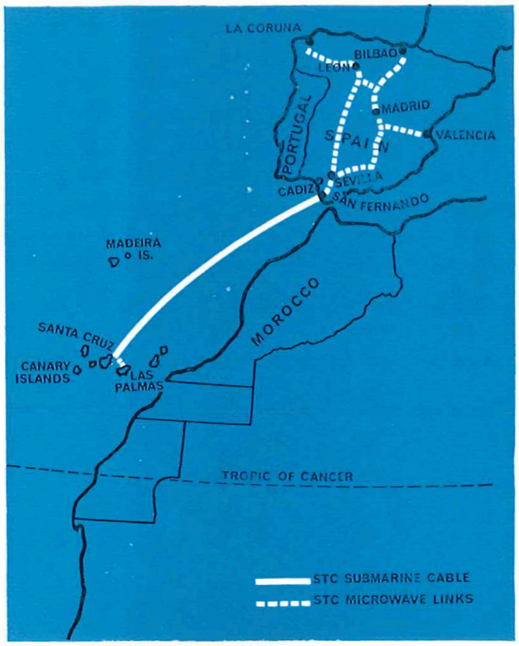

Canaries on the line

STC are to make and lay Spain's first-ever submarine telephone cable link between the Peninsula and Canary Islands. The system will be designed for 160 telephone circuits in both directions over a single cable and thus will be the highest capacity long-distance cable yet installed. This £2,500,000 order represents a key feature of Spain's major expansion in telecommunications. Laying will commence in the late spring of 1965. Service will open in the summer. The link, measuring 750 nautical miles — 710 miles of deep-sea lightweight cable and 20 miles of shallow-water armoured cable at each end — will connect San Fernando, 10 miles south of Cadiz with Santa Cruz de Tenerife. 45 STC deep-sea repeaters, 3 adjustable submarine equalizers and terminal equipment will be supplied with the cable. STC with its associated company, Standard Electrica S.A., will also provide a microwave link between Tenerife and Las Palmas which will form part of the service. High-quality speech circuits will be provided, day and night, with Europe (direct dialling to Madrid) and North America.

Standard Telephones and Cables Limited, Submarine Cable Division, West Bay Road, Southampton, Hants. Telephone Southampton 74751. Transmission Group, North Woolwich, London E.16 Telephone ALBert Dock 1401. Telex 21645.

world-wide telecommunications and electronics **STC**

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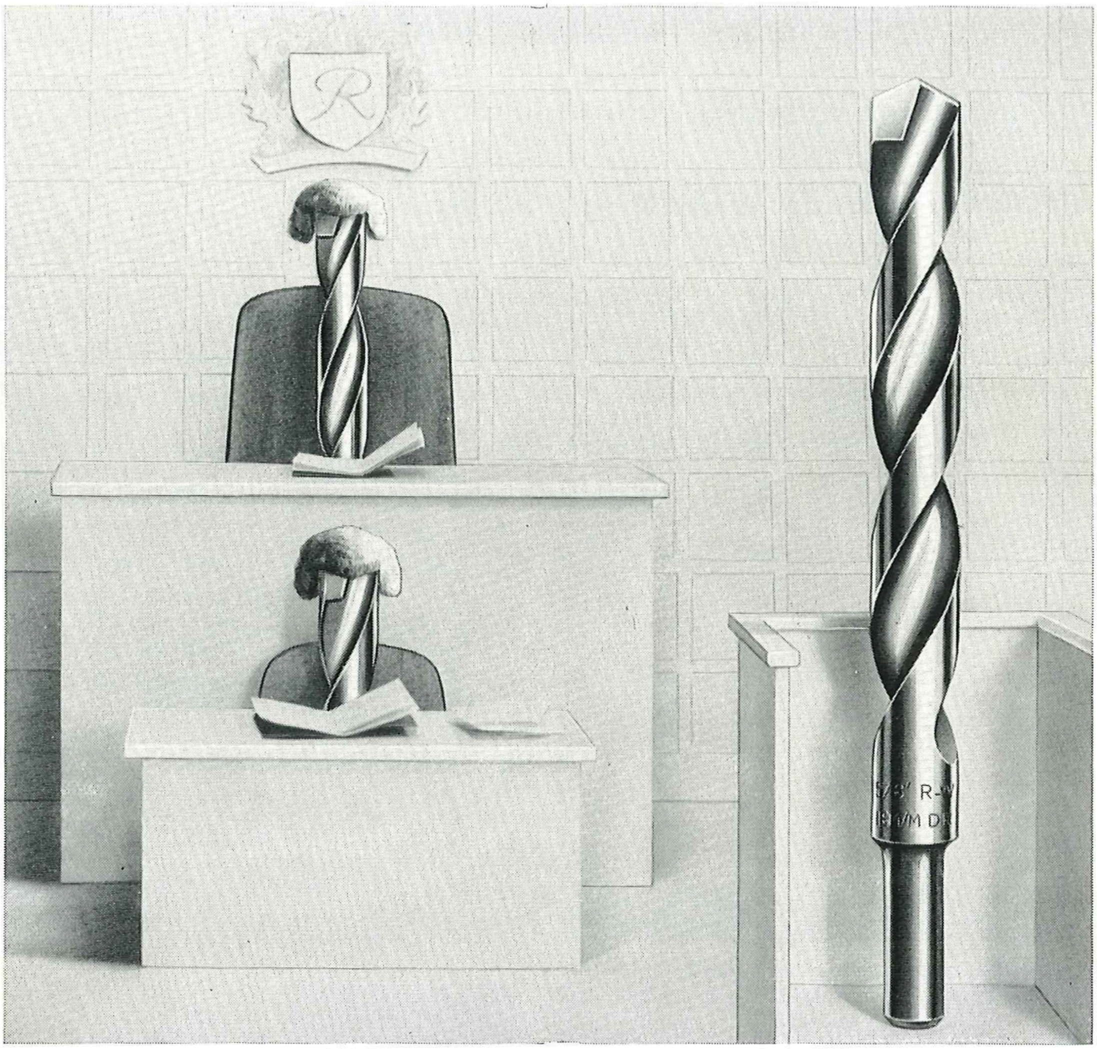
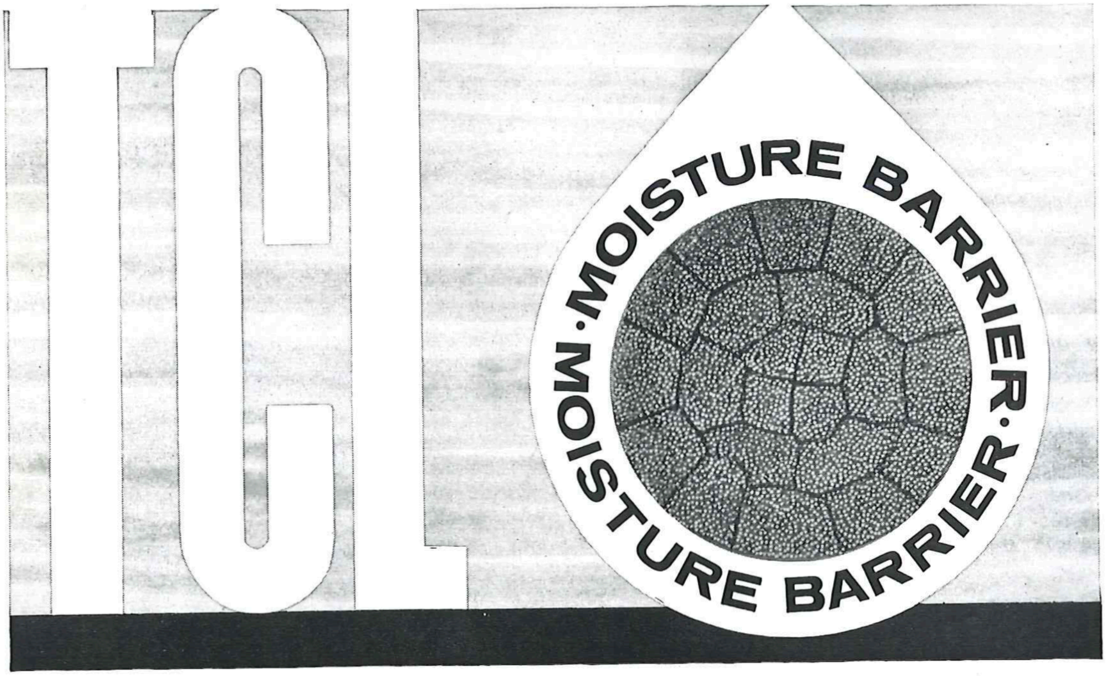


new paper-insulated plastic sheathed moisture barrier cable by



Lighter—for easier handling, longer lengths, fewer joints
Working life equal to lead sheathed and protected cable

Paper insulated plastic sheathed cable can now be employed under conditions hitherto confined to lead sheathed cables. Developed in conjunction with the British Post Office, this new T.C.L. cable incorporates paper insulated conductors sheathed with polythene having aluminium foil bonded to the inside of the sheath to form a moisture barrier.

This barrier effectively prevents the diffusion of moisture vapour through the polythene sheath which would result in a lowering of the insulation resistance.

This produces a cable having electrical characteristics equal to a lead sheathed cable and being light in weight has many economic advantages, plus freedom from sheath corrosion. Besides forming an electro-static screen, the aluminium foil can also be used to detect insulation failure due to any mechanical damage.

T.C.L. moisture barrier cable at Windsor Castle

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Post Office Telecommunications Journal

Published by the Post Office of the United Kingdom to promote and extend knowledge of the operation and management of telecommunications

Contents

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Vol 16 *Winter* 1964 *No.* 4

The Challenge of the Future

THE message which the new Postmaster General, the Rt. Hon. Anthony Wedgwood Benn, MP, has sent to all members of the Post Office presents an inspiring challenge to everyone at all levels in the organisation.

"The GPO has a world-wide reputation for enterprise and technical achievement. All those who work in it are rightly respected for their efficiency, dedication and deep sense of public service," says Mr. Benn.

"Ours is a science based industry at the beginning of a new period of immense growth made possible by the explosive nature of new inventions and techniques, which will revolutionise many of our operations and give us a vital role in the further development of the nation. Nor must we ever forget that it is the intricate web of modern communications that has shrunk our world and created the situation in which we all have become close neighbours, intimately concerned with each other's survival and welfare.

"Whatever our own particular job in the Post Office may be, we all have an opportunity and a duty to see how we can improve the work we do. We must be ready to think everything out afresh.

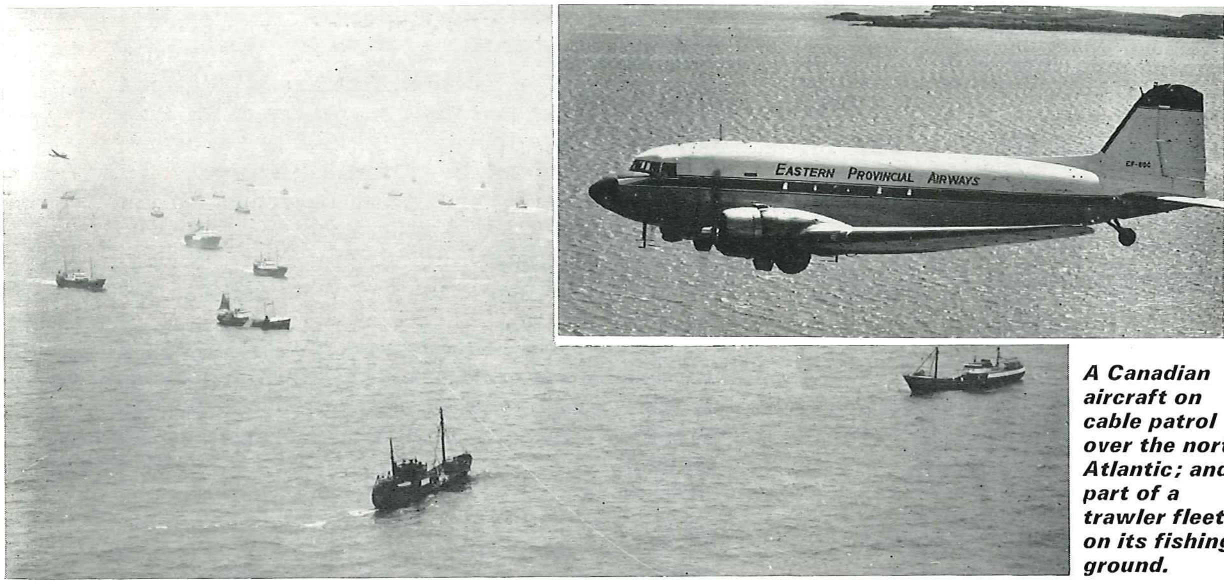
"A gigantic task lies ahead of us," the new Postmaster General adds. "The future of this country depends on the extent to which we all share the sense of excitement that looking forward ought to stir within us. One thing is certain. It will require each of us to develop to the full such qualities of imagination and innovation as we possess.

"This is the spirit in which I have taken up my new job and I would like to send my warmest good wishes to all my colleagues in this great Department."

The task of preventing damage to submarine cables is formidable but it is being tackled with imagination and energy. In the Newfoundland area, for example, air and sea patrols are carried out to overcome the . . .

HAZARDS ON THE OCEAN BED

By G. H. JENNERY



A Canadian aircraft on cable patrol over the north Atlantic; and part of a trawler fleet on its fishing ground.

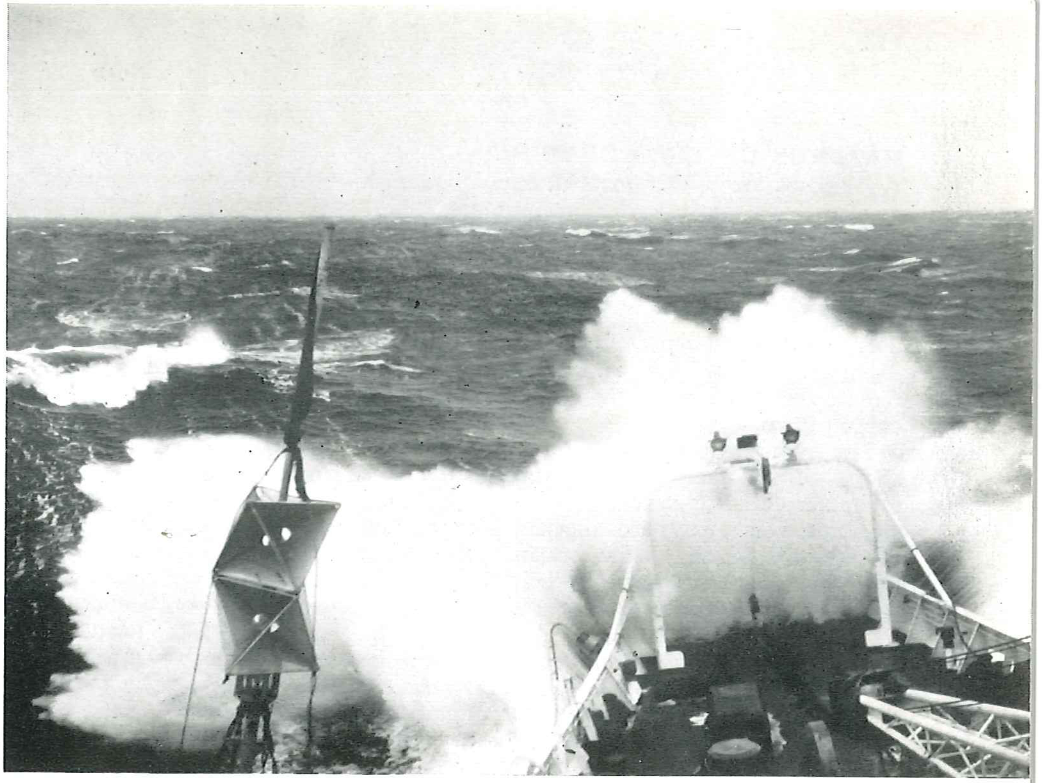
THERE are sea areas which viewed from the air look relatively innocent. The Grand Banks of Newfoundland is one example. Here, fishing trawlers from all parts of the world converge. And on a good fishing day the scene would never strike one as holding any hazards.

To the trawlermen the hazards lie deep below. This area, rich with fish such as cod and haddock, is also criss-crossed with submarine cables. Not only are cables damaged and disrupted by nets, and heavy otter boards, but expensive fishing gear is frequently being lost through entanglement with submarine cables.

It is not possible to restrict the activities of trawlermen. The most one can hope for is their co-operation in avoiding a cable when their attention is drawn to its proximity. In the past cable owners have diverted portions of their cables from areas most frequented by trawlers only to find that the new locations have later developed into profitable fishing grounds.

To protect the important submarine telephone cables in the Newfoundland area—an area which includes TAT1, TAT2, CANTAT and ICECAN, a ship patrol, assisted by air patrols is kept daily throughout the fishing season. This was organised mainly by American Telephone and Telegraph Company; Canadian Overseas Telecommunication Corporation; French and German Administrations; and the British Post Office, who are the owners of the important telephone cables.

Generally speaking only one ship is used at any time, except during busy periods. The ships are



HMTS* Alert *on patrol in choppy seas in the north-west Atlantic, ready to warn trawlers to steer clear of cable routes. Note the radar reflectors on the cable buoy.

HMTS *Alert*, Western Union's cable ship, *Cyrus Field*, and the small French vessel *Langlade*. The air patrols are mounted daily from Sydney, Nova Scotia, or twice or three times weekly from Gander, Newfoundland, weather and visibility permitting.

The air patrols reveal concentrations of trawlers in a particular area, and the cable ships advise trawlers in their vicinity that they are engaged on a cable protection patrol. They ask trawlermen to co-operate by avoiding cable routes and offer any other assistance in the mutual interests of both.

To gain attention, loud hailers, flag signals, large placards inscribed "Cable Protection Patrol", are used, and also, radio telephone. A short message in nine languages is broadcast on special tapes. These are prepared for this purpose by the foreign news staffs of the BBC. Similar messages are also broadcast by French and Canadian radio coast stations in the area.

The cost of patrolling has been increasing yearly, now being about £400,000 a year. This may seem a large amount. But, as a method of reducing cable interruptions to the minimum this expenditure has been considered justified by the countries concerned.

Wide press publicity is also given in an effort to help solve the problem of cable damage. The telecommunications industry in particular, makes ceaseless efforts to make knowledge of the problem widespread. Co-operation between the two industries involved is the best immediate way known to achieve results.

Because it is not entirely a one-sided story, solving the problem of cable damage is a formidable task. The Cable Damage Committee—an international consortium of government communications and cable-owning companies, formed in 1958, undertakes the task of establishing the goodwill and co-operation of deep-sea fishermen, by asking them to avoid whenever possible operating in areas where cables lie.

The fishermen until recently, could not respond fully to this request. They were handicapped by Government restrictions which did not permit routes of submarine cables to be shown on fishing and navigational charts. However, by persistently presenting its case in the strongest terms, the Cable Damage Committee has now overcome this difficulty.

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HAZARDS ON THE OCEAN BED (*Contd.*)

It has obtained Government clearance to publish its own charts reproduced from Admiralty charts. These have the cable routes superimposed out to the 500 fathom line. The charts were distributed free of charge to trawler owners and skippers, but they have the disadvantage that they cannot be used for navigational purposes. Until new Admiralty fishing and navigational charts can replace them, fishermen are being encouraged to consult them.

The Admiralty project of putting cables on their charts will inevitably take some considerable time to implement. But once completed they should constitute a big step towards alleviating the problem of under-sea damage. Some foreign hydrographic departments are also revising their charts in the same way, whilst others have the question actively under consideration.

The Cable Damage Committee have meanwhile arranged with the firm of Imray, Laurie, Norrie and Wilson, Ltd, who publish charts, for a number of their charts to be reissued showing cable routes. These are already being used by fishermen, who welcome this additional information.

That the knowledge of the route of a cable is essential to fishermen, if damage is to cease, becomes obvious when the otter trawl is described.

This is a device for taking demersal fish; fish which live on or near the sea bed, such as cod, haddock, redfish, whiting. Assembled and rigged, the otter trawl takes the form of a huge net bag travelling along the seabed. Its mouth is kept open by trawl doors or "otter boards". And these are dragged along the bottom of the sea at an outward angle from the direction of the towed trawl.

Swept into the belly of the net by the wings, the fish are trapped in the "cod-end". The net is usually towed at two to three knots using flexible steel wire cables. And a good haul can average a ton of fish or more.

The theory on how fouling occurs is based largely on conjecture, though experiments have been made which show how an 'otter board' properly maintained can cross a cable without damaging it. Snagging would almost certainly occur as the trawler ends the tow, and swings round to haul in the catch. In that case the "otter boards" flatten on the bottom and when the trawl is raised the leading edge of a board may pass under a cable. A cable can easily be fouled where it lies in tension over a bottom depression.

Under the terms of the International Convention of 1884, for the protection of submarine cables, owners of ships and vessels who can prove that they have sacrificed an anchor, a net, or other fishing

A trawler skipper and his mate study a chart for submarine cable routes. A trawler which "catches" a cable can suffer a great deal of damage and financial loss. Picture: Courtesy Fishing News.

gear, in order to avoid damaging a cable, will be indemnified by the owner of the cable. The wilful damaging of a cable is, however, under the terms of the Convention, a punishable offence.

What the Cable Damage Committee recommend, is for fishermen always to carry charts showing the cable routes, and thus avoid trawling near cable routes, or having trial runs across these routes. Should a trawler accidentally hook a cable their advice is, abandon gear, and claim compensation for it.

THE AUTHOR

Mr. G. H. JENNERY, is a Higher Executive Officer in the External Telecommunications Executive and has been Secretary of the Cable Damage Committee since 1962. He joined the War Office in 1940 and was actively concerned with the formation, and wartime operations of the Royal Pioneer Corps, and assisted in compiling a "Monograph on Military Labour" for War Office records. Transferred to the Post Office in 1948 as an Executive Officer, Mr. Jennery was promoted to his present rank in 1951. Apart from Cable Damage Committee activities, he is concerned with new submarine telephone cable projects. Until 1940 he was a Merchant Navy Officer for 20 years.

A broken cable has been recovered and joined on board HMTS* Alert*. Now, in the ship's test room, the moulded core is prepared for X-raying before the repaired cable is given its outer polythene sheath.

Signor G. C. Perugia, of the BBC's Italian Service, records a message in Italian warning trawlers of the proximity of submarine cables. These messages are broadcast to trawlers by the patrol ships.

Continental Exchange Assistant Supervisor L. L. Domingue instructs a language class

How the Post Office hopes to overcome the problem of recruiting staff with suitable linguistic ability is told

By D. A. SCRIVENER

ICI ON PARLE FRANÇAIS

THE Post Office is soon to have its own language laboratory for training French-speaking telephone operators. This important measure is being introduced to reduce the duration, and therefore the cost, of the language training course that operators with a basic knowledge of French receive in order to improve their knowledge to the standard required.

Linguist operators in the overseas telephone service must have a good command of conversational French equal to, or higher than, GCE "A" level and recruiting of staff with suitable linguistic ability has long been a problem for the Post Office. Approximately 150 men and women able to speak French fluently apply to become linguist telephonists each month and these fall mainly into two categories—those who have lived abroad for some years and those who have reached "A" level at school and who may have spent a holiday in France or have lived there for some time. Not all are suitable for training as telephonists, however, and the limited number of fully-qualified linguists accepted falls far short of requirements.

For this reason, the recruiting field was extended some years ago to include those with a fair knowledge of French, roughly equivalent to GCE "O" level, and who show promise of becoming fluent linguists with more tuition and practice.

Language training for these potential linguists does not begin until, at the end of 24 weeks or so, they have completed a basic Continental telephone operator training course and passed an operating efficiency test. Then, when they have consolidated their operating procedure, they are placed into classes of up to 10 in number and for two hours a day for about 20 weeks receive instruction in French. The main emphasis is on oral practice which varies from reading text books to taking

part in discussion groups. Phrases and words based on the telephone language commonly used by operators are introduced into the lessons so that the students are already familiar with them by the time they operate on French-speaking routes. Tape recorders are used to demonstrate diction and pronunciation and reveal students' weaknesses.

When the tutor feels that a student has reached the required standard, she is allocated to a section of the exchange dealing with calls which require her to converse in French with operators in that country. During this part of the training the operator is assisted by a coaching supervisor and although the length of the training period varies according to the ability of the student, six weeks are usually needed before she thoroughly learns the operating techniques and peculiarities of the French-speaking, or "ling" routes. The student is then given a test in French by a member of the Continental Traffic staff and, if successful, is upgraded to Class One linguist. This qualification entitles her to a monetary language allowance. In the past three-and-a-half years some 750 telephonists have received French class training and nearly all of them successfully reached the Class One standard.

The present training system means that a potential linguist recruit cannot give the Post Office useful full-time service as an efficient linguist for at least a year. This is uneconomical and frustrating to the staff. A new system which keeps training time to a minimum without loss of efficiency is needed and it is to meet this requirement that the Post Office has decided to set up a language laboratory.

One of a language tutor's chief problems is that some students inevitably progress faster than others and there is little alternative but to devote more individual attention to the slower students and neglect those making good progress. In addition, some students are self-conscious and reluctant to appear foolish or lacking in ability in front of their classmates.

The language laboratory is designed to overcome these difficulties by providing all the facilities needed to achieve a direct working relationship between the tutor and each student independent of the others.

Various methods are used to attain these conditions and their efficiency is closely related to their cost. The cheapest system provides a portable console which accommodates up to 10 students and consists of a tape recorder and a headset for each student. The headset, which fits tightly to cut out all background noise, is of the double receiver type and incorporates a transistorised amplifier in one earpiece. The student speaks into a microphone attached to the headset and hears her voice not

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A typical language laboratory at work

through the bone structure of her head in the normal way but through the amplifier, thus enabling her to assess the quality of her voice. A pre-recorded tape played through the deck of the console offers phrases to the pupil who repeats them during a pause in the recording. The instructor can monitor or speak to any student at any time without interrupting the others and recordings of individual students can be made by introducing a second tape recorder.

This system suffers from the disadvantage that only one student can be recorded at any one time, and, while students learn from the mistakes of others, only about one-tenth of the practice is given personally to each student. In addition, the headsets are heavy and uncomfortable to wear.

A more advanced and ambitious type of equipment is the full language laboratory and this is the kind the Post Office plans to introduce for teaching potential linguists. It consists of an individual sound-proof booth and tape recorder for each student. The control console and tape recorder enable the instructor to monitor and speak to students individually or collectively and to control all the tape recorders. Under this system each student has a pre-recorded tape and can work independently of the rest of the class. It is possible, for example, to train simultaneously several groups of students of different standards—a feature which helps considerably to save training time. Complete individual tuition without the discomfort of heavy headphones is possible and all students can record themselves and hear their own progress independently. The tape recorders are designed so that a spare machine can be plugged in while a faulty one is being repaired. And multiple pre-recorded tapes can be produced in one operation—either before or during a lecture.

The new console envisaged by the Post Office will not dispense completely with classroom training. It is envisaged that the laboratory will be used for about half the total training time to complement classroom lectures. Because there is little need for a telephonist to be able to read or write French, the emphasis has always been on oral practice, but in a class of up to 10 students this part of the curriculum is cumbersome and time-wasting since it can only be really effective when carried out on an individual basis. It is in this respect that a language laboratory, with its facility for providing individual tuition and practice is far more efficient and time-saving.

Training given in the new language laboratory will also enable students to practice with a fair degree of realism the recording of details of calls. For example, it would be possible to simulate a typical message from a Paris operator saying, "*Monsieur Jacques Dominque sera là a quatorze heures cinquante a Paris/Opera soixante douze vingt sept*" (Mr. Dominque will be available at 14.50 hours at Paris/Opera 7227). The student would repeat the message firstly in French and then in English.

It is too early yet to say by how much the new language laboratory system will reduce the time taken to produce Class One linguists, but it is not too optimistic to hope that the French training period can be reduced by up to a half.

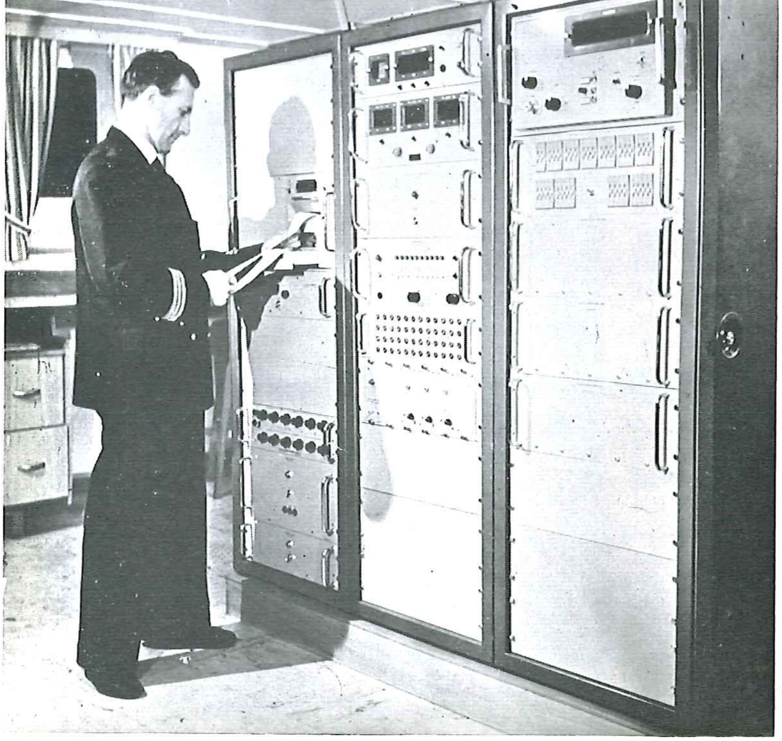
The London Continental exchange handles all manually connected telephone calls to the Continent, the majority of which are controlled by operators who can speak fluent French.

Contrary to popular belief the Continental Exchange telephonists need not be multilingual. French is the main language used in service conversations between operators although a number of countries have agreed with Britain to use English as the service language.

Some of the Continental Exchange staff can speak a number of languages and a few allowances are paid to those who can speak Spanish, Italian or German. But these languages are rarely used and then only when there is some difficulty—for example, to help a visitor to this country who can speak no other language.

THE AUTHOR

MR. D. A. SCRIVENER, is a Telecommunications Traffic Superintendent in the Guildford Area. He joined the Post Office in 1949 as a Youth-in-Training and transferred to the Traffic Division as a Telecommunications Traffic Officer in 1954. In 1961 he was promoted to his present grade in the External Telecommunications Executive where amongst other duties he was responsible for the training of overseas telephonists. He transferred to the Guildford Area in 1963.



A Chief Engineer examines punched tape leaving the data recorder equipment. This provides the signal sent by the ship's radio transmitter.

A NEW SHIP-TO-SHORE DATA SERVICE

A NEW maritime high frequency radio-telegraph service has recently been introduced which enables tankers operated by the Shell International Marine Company to transmit data signals directly into computers at the Shell Centre in London where they are immediately decoded and analysed.

The opening of this new service, in which the Post Office has played an important part, means that the Shell International Marine Company can now predict the dates when their vessels require overhaul from information collected while the ships are at sea and so achieve considerable economies in the operation of their tanker fleet. Hitherto a ship's performance could be tested only by taking the vessel out of service and putting it through a series of trials over a measured mile.

This latest development to keep pace with the communications needs of the shipping industry began in July, 1962, when the Shell Company asked the Post Office for data transmission facilities so that changes in the performance of their ships could be detected almost immediately in London.

By that time the Company's engineers had developed and adapted a number of new data logger instruments to record various types of information about the performance of ships.

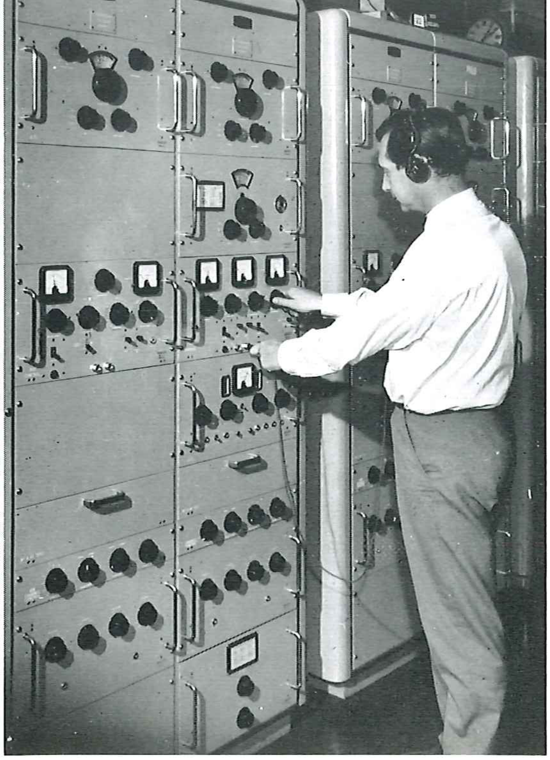
For the Post Office the problem was how to provide a radio link between the ship and shore since the long-range radio-telegraph service then had no suitable equipment immediately available. A number of experiments were arranged and data in the form of groups of figures was transmitted from one of the Company's oil tankers during her voyages between Britain and the Far East into the

OVER

Shell Centre in London.

In the initial experiments the radio link was provided by the Post Office radio stations at Rugby (transmit) and Bearley (receive) and the data sent by landline by way of the Brent terminal and the International Exchange to the Shell Centre. At Bearley specially adapted single sideband receivers and space diversity aerial systems were employed. On board the ship and at the Shell Centre, Marconi autospec telegraph automatic error detecting and correcting equipment was installed to provide a virtually error-proof connection. The information collected by the recording instruments on board the tanker was transferred to punched tape and fed to the ship's autoplex equipment, which translated the signals into a special 10 unit code and passed it on to the ship's radio transmitter, operating in the new wideband telegraphy channels, at a rate of about 300 characters a minute. The use of this 10 unit code enabled Shell Centre's autoplex equipment to correct automatically most of the errors introduced by the vagaries of the radio link, and to print a special symbol rather than a wrong figure for most of the more complicated signal mutilations which the system could not correct automatically.

The system has already proved highly successful and the Post Office is now installing additional radio transmitters and single sideband receivers and facilities for diversity reception so that suitably



A Technical Officer at Bearley Radio Station tuning up an independent sideband dual diversity radio receiver.

An operator at the Shell Data Process Centre supervising data tape to punched card conversation.

equipped ships anywhere in the world will be able to transmit data and other forms of automatic telegraph by way of the long-range coast stations at Burnham and Portishead. The Post Office ship-to-shore service will act as the link between the ships and their shore offices and initially the special telegraph sending and receiving equipment will normally be owned and maintained by the users.

By the end of September the Shell International Marine Company had fitted out 13 of its ships with the equipment needed for them to take part in the new service and by August about 80 to 90 separate transmissions of data a month were being sent from six of the Company's tankers.

Shortly before this article went to press the Post Office and the Shell International Marine Company took part in a series of test transmissions of data—separately and simultaneously in both directions: from the oil tanker *SS Hemifusis* on sea-keeping trials to the Shell Centre and in the reverse direction. This was the first time that data had been transmitted in both directions between ship and shore.

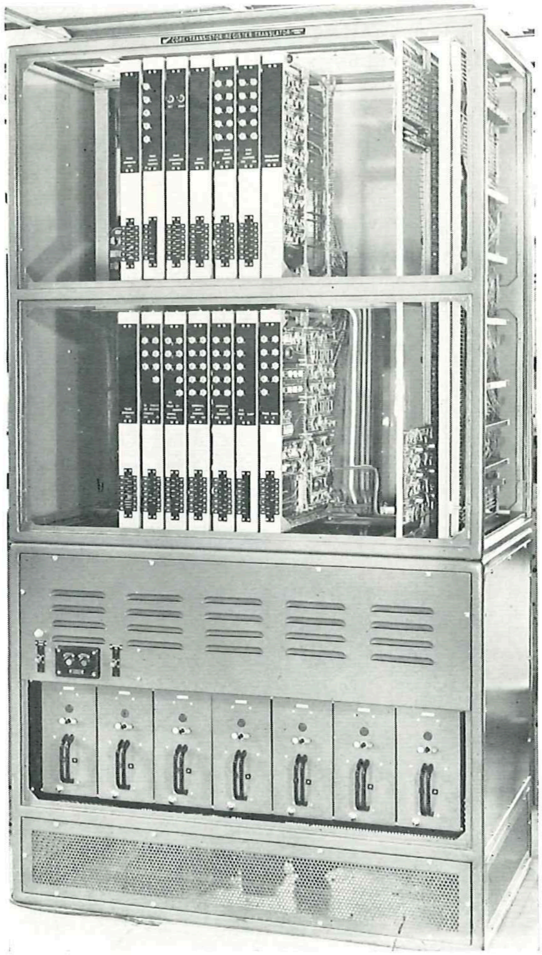
The tests, which involved the exchange of data almost every day for abour six weeks while the *SS Hemifusis* was on passage from Britain to Curaçao and thence to Durban and Lagos, showed that given a reasonably good transmission path a sufficiently low error rate could be achieved. Only on relatively few occasions did the exchange of data fail because of poor radio conditions and sometimes it was apparent that data could be satisfactorily received over a circuit almost unsuitable for intelligible speech.

An operator at Shell Data Process Centre accepting a call from a ship's radio officer and noting the ship's position and frequency for transmission.

A two-and-a-half-year trial with a new style experimental electronic director equipment for automatic telephone exchanges ended recently. The equipment set up about 15 million calls. Its performance was so encouraging that a production version for use in incoming trunk switching units in Director Areas and employing the same techniques is now being manufactured for the Post Office

BALHAM POINTS THE WAY

By C. K. PRICE



The new electronic director equipment at Balham which is based on the magnetic core technique. In just over two-and-a-half years the Balham director system handled 15 million calls.

RICHMOND, Lee Green, Balham. No, not a new London underground railway but, to Post Office telecommunications engineers, significant place names nonetheless. The telephone exchange at each of these places has been used, in turn, to try out new methods of switching telephone calls.

In the years immediately after World War Two engineers were interested in electronic switches known as cold-cathode tubes—small, gas-filled valves, like tiny neon signs, operating without the need for a heater which is the main drawback of the ordinary radio valve. This interest culminated in the installation at Richmond Exchange of several experimental switching equipments using cold cathode tube circuitry. These equipments successfully handled public traffic for about six years.

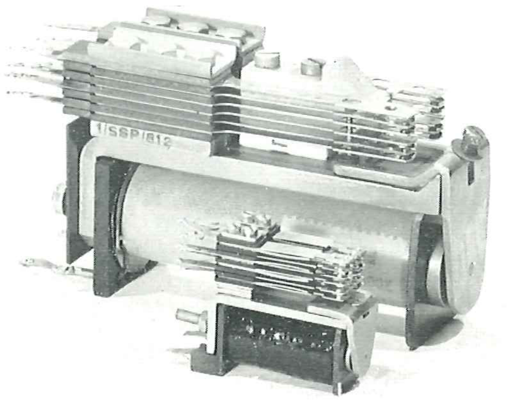
In the middle 1950s magnetic drum techniques, borrowed from the growing computer field, were

applied to the design of similar equipment and the second trial opened at Lee Green Exchange in 1957. This used a magnetic drum and (because of the high speed at which they were required to work) circuits based on radio valve techniques. This trial equipment handled public traffic for about four years.

The most recent trial in the series, which began at Balham Exchange in June, 1961, and came to an end in February, 1964, was based on the use of magnetic cores and transistor circuitry and demonstrated that this technique can be extremely reliable.

The subject of these three trials was the director—the brain of every exchange installed in London, in Edinburgh and in the larger provincial cities. The director is, in effect, a mechanical telephone operator and in densely populated areas which are necessarily served by a large number of telephone exchanges, it helps the customer to get his calls very much more easily than might otherwise be possible. In a director area, for example, the numbering scheme is designed so that no matter from which exchange in the system a call is originated, the objective exchange will always be obtained by dialling the one code assigned to it. A director system helps the engineers too, its flexibility making it possible to design efficient inter-exchange networks. It is usually only economic to use a director system in places where the telephone density and calling rates are high. In the case of STD, however, where the whole country is treated rather like a single director area, the complexities of routing and charging make it very desirable to employ director-like equipment to control the calls. This equipment is referred to as register-translators rather than directors, although the functions of both are similar.

The essential feature of a director, or register-translator, is that it must be able to store information on a relatively large scale. Two sorts of information storage are involved. First, the retention of the digits dialled in by the caller and second, storage of all information necessary for the machine to be able to control the actual routing of calls. Compare these requirements with, say, the needs of a telephone operator when handling a call. She might first make a note of the wanted number on a slip of paper or docket (equivalent to the first store) while consulting the routing file which contains all the information she needs to route any call to its destination (equivalent to the second store).



This picture shows the miniature relay (now named the Post Office type 16 relay) compared with the 3,000 type relay it replaced at Balham.

The director system equipment was originally designed, and the first exchanges installed, in the middle 1920s. The present-day director equipment still works on the same principles although the component parts have been improved by continuous development. Incoming digits are stored by means of two-motion selectors and uniselectors while the routing information is retained by means of patterns of wire links on panels—one panel for each director and referred to as a translation field.

Like the human telephone operator, the directors in an exchange only set up the calls and, since only relatively few are required for this purpose, they are heavily worked and require a good deal of maintenance attention. Should even a single fault escape attention the result will be a noticeable degradation in the quality of service offered to the customer. For these reasons maintenance charges on this type of equipment tend to be high, hence the search for techniques which will give high reliability for low maintenance cost. Electronic equipment provides the solution—hence the interest in the trials at Richmond, Lee Green and Balham.

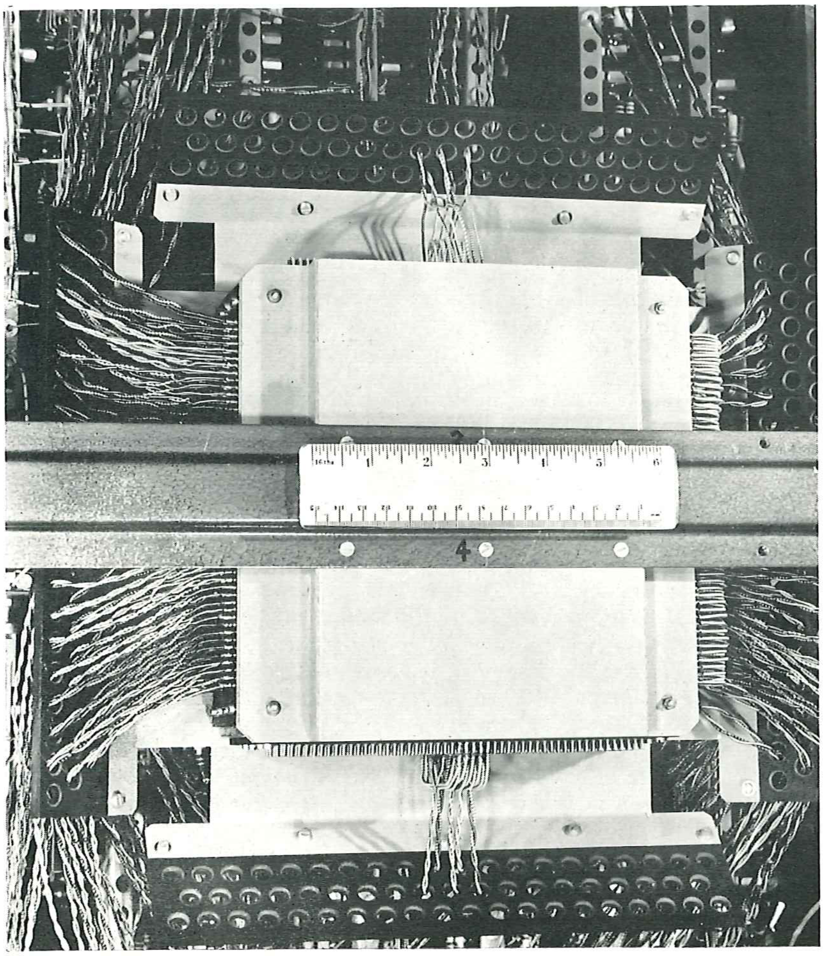
The magnetic core model director equipment was offered to the Post Office for evaluation in the summer of 1960. Like the magnetic drum system before it, it closely resembled a digital computer. Its subsequent performance in a Post Office laboratory was so encouraging that it was decided to install it in a public exchange and Balham, in the London Telecommunications Region, South-West Area, was selected. Between 26 June, 1961 and

OVER

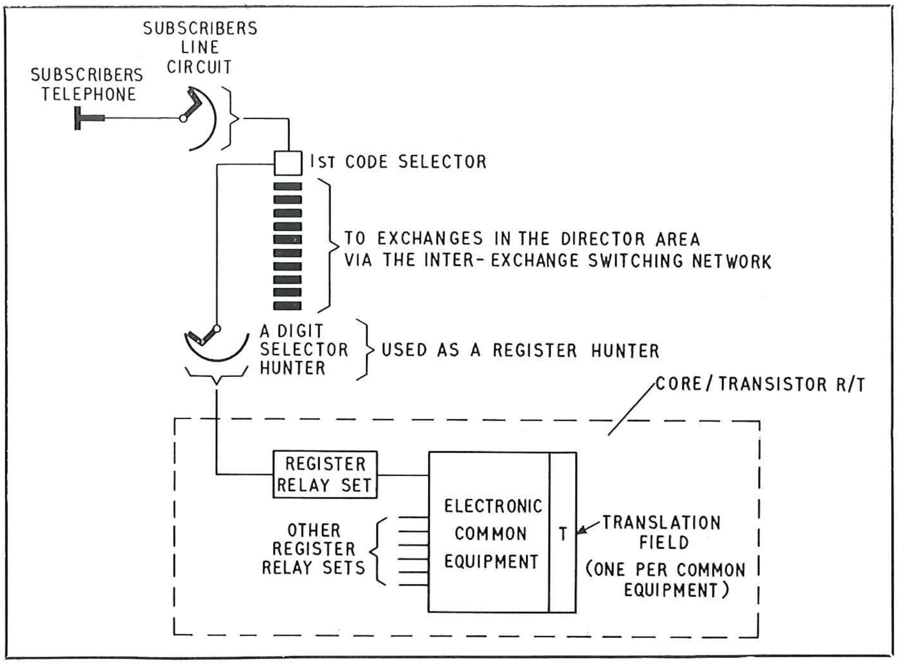
BALHAM POINTS THE WAY *(Contd.)*
18 February, 1964, the 10 inputs with which it was fitted experimentally, handled approximately 15 million calls. About nine million (or 60 per cent) of these were made by the public while the remainder were artificially generated for test and supervisory purposes. The equipment contained 3,600 transistors and allied devices, 3,000 magnetic cores, 6,000 other components and an estimated 50,000 soldered connections. During the period of public service the component faults affecting service on the wholly electronic section of the equipment amounted to four transistors, one resistor and eight high resistance connections. Indeed, for the major part of the trial the electronic equipment operated continuously without faults.

The installation also contained about 150 relays and 15 uniselectors and this apparatus produced on average 50 faults a year. It was found, however, that the performance of some non-standard, miniature relays was even better than the well-tried Post Office 3,000 type relay. Subsequent laboratory tests confirmed the findings at Balham and this type of miniature relay has since been coded as the Post Office type 16 relay. Production versions of core type incoming trunk switching register-translators will use this type of relay in the electro-mechanical parts of the equipment.

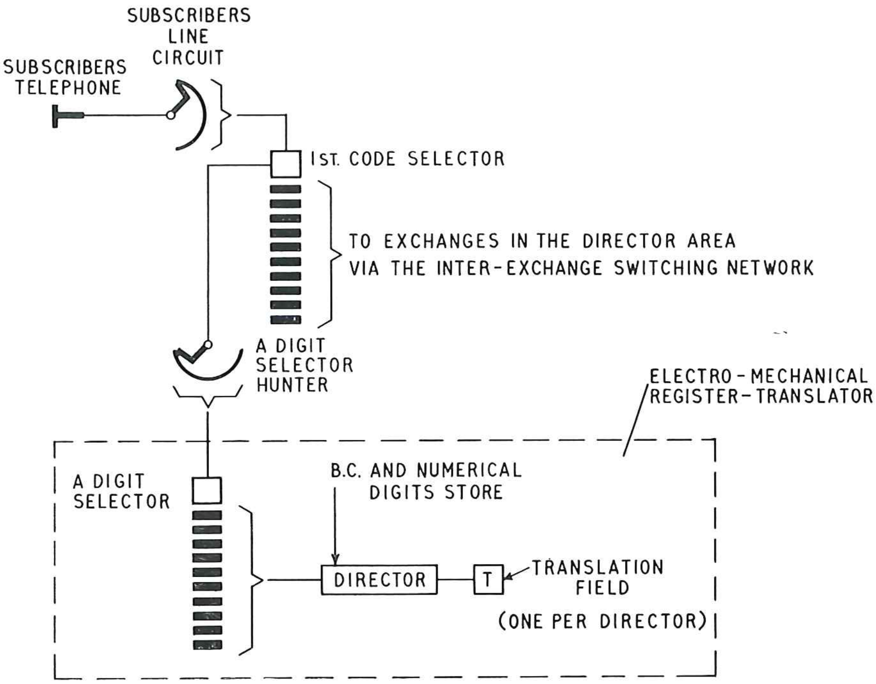
It is beyond the scope of this article to describe in detail how the core-transistor director equipment functioned. A technical description was published in the *IPOEE Journal*, January, 1964. Equipment of this type generally comprises a single, common processing unit and a number of inputs, each with an associated information store known as a register. The processing unit is connected in turn to each register and information passed each way between the two very rapidly. This



The register matrix box, measuring only nine by six by three inches, containing ferrite cores which can store 10,000 "bits" of information. This piece of equipment can be likened to an electronic chess-board.



This diagram shows the trunking of the Balham Exchange with the electronic director equipment installed.



A diagram of the trunking of Balham Exchange without the electronic director equipment.

procedure can best be likened to a multiple chess game in which a master plays several competitors simultaneously. The master (the common processing unit) moves from one opponent (input) to the next in turn, examining each chess board (the input information store), noting the current move and the stage of the game and then deciding his move. His decision will also depend on the rules of the game (that is, he is said to be programmed). For such multiple games to proceed satisfactorily, the master must operate much more rapidly than

OVER

BALHAM POINTS THE WAY *(Concluded)*

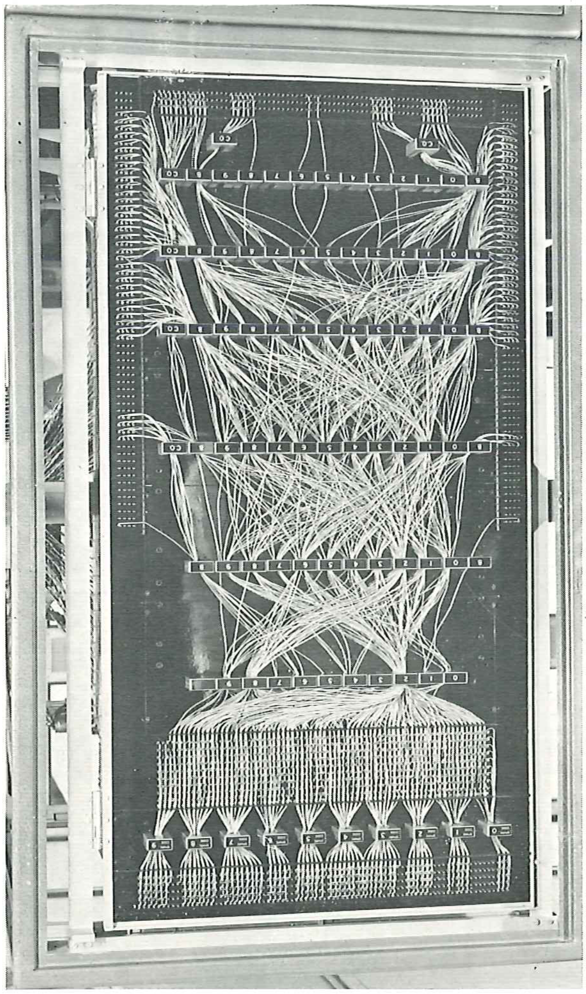
his opponents can and so it is in the case of time-shared electronic common processing equipment.

The electronic chessboard (the individual input information store) was required to hold 100 bits of information in the Balham model. Since the model had a capacity of 100 inputs the total input information storage amounted to 100 times 100, or 10,000 bits. Ferrite cores, one core per bit, were used for this storage function. (Information in digital computer systems is expressed by means of groups of digits which in themselves can have only one of two values—0 or 1. The number 5, for example, can be expressed in such systems, typically as 0101. Each digit or element making up the piece of information, sometimes called a word, is known as a bit.)

A magnetic core is a tiny ring of ferrite material, sometimes only 20 or 30 thousandths of an inch in diameter. The material is made by kiln-firing a compressed mixture of powdered oxides of manganese, magnesium and iron. A core can be magnetised in either of two directions by passing a sufficiently large current through a winding placed on the core. Reversal of current causes reversal of magnetisation and the core will remain in either magnetised state indefinitely. A ferrite core can, therefore, remember the state of one bit of information (0 or 1), having only to be magnetised in one direction or the other. When the direction of magnetisation is reversed, a voltage with polarity corresponding to the change will appear across a second winding on the core, hence when the state of magnetisation is to be determined, a current of known direction is applied to one winding on the core while the second winding is checked for the presence of an electrical output voltage.

The short period during which the input information store is associated with the processing unit is divided into three phases—read, decide and rewrite. In the Balham equipment these phases occupied 166⅔-millionths of a second. In the production version this time has been halved.

The first phase is the extraction of information from the input information store of the register. A field-reversing current is sent along a wire threading all the cores in the group which form the store so that a pattern of electrical voltages appears which can be interpreted by the processing unit. This is the read process. Next, the processing unit decides courses of action based on information received from the store and on its own programme. During this period, too, commands may be issued to the input equipment. In the last phase, the



This picture shows the translation field used during the experiment at the Balham Exchange. Each row of transformers represented a digit and each transformer in each row a value between 1-0.

read-out information is up-dated and then returned to the input information store. This sequence of operations is then repeated on all other registers in the system in turn. Each register is connected to the processing unit once every 16⅔-thousandths of a second.

The processing unit has available to it a routing information store which enables the processing unit to convert the dialled-in exchange codes into digits which, when pulsed out, route the call through the network to that exchange—a process known as

translation. The storage of the many routings to be catered for is achieved by the running of flexible, insulated wires (one for each routing) through specified groups of transformers on a panel known as a translation field. This method is simple and reliable and enables particular routings to be easily verified and, if necessary, modified.

The Balham experiment has demonstrated that properly designed electronic systems can improve productivity in the Engineering Department and also help to improve the service the Post Office gives its customers. Production versions of ferrite core type register-translators will shortly be coming into operation in London and elsewhere to switch thousands of trunk calls daily to their destinations.

**The author is indebted to Ericsson Telephones Ltd. who designed and constructed the trial electronic director equipment and for permission to use their photographs of the equipment.*

THE AUTHOR

Mr. C. K. PRICE is an Executive Engineer in the Engineering Department (TPD Branch) where he is particularly concerned with the development of ferrite core type register-translators. He joined the Post Office in 1941 as a Youth-in-Training in the Gloucester Telephone Area and was transferred to the Engineer-in-Chief's Office in 1949.

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The New Men at the Top

Left: The Rt. Hon. Anthony Wedgwood Benn, the new Postmaster General.

Right: Mr. Joseph Slater, the new Assistant Postmaster General.

AT 39, the Rt. Hon. Anthony Wedgwood Benn, MP, is one of the youngest Postmasters General for many years. He is also the first journalist to become political head of the Post Office.

Mr. Wedgwood Benn, a World War Two pilot and former BBC talks producer, was first elected to Parliament in 1950 when he won the seat at Bristol South-East and was subsequently re-elected in 1951, 1955 and 1959. On succeeding to a peerage as Lord Stansgate in November, 1960, he was disqualified but was re-elected in May, 1961, after which he was unseated by an election court and replaced by his defeated opponent. Mr. Wedgwood Benn led the campaign to allow renunciation of peerages and on 31 July, 1963, only seven minutes after the law was changed, he renounced his peerage and returned to Parliament later that year.

Mr. Wedgwood Benn is married to an American novelist and writer and has three sons and a daughter. The Labour Party's principal spokesman on transport in the House of Commons after the 1959 election, Mr. Wedgwood Benn is keenly interested in foreign affairs and has travelled widely in Europe, America, Africa and India.

The new Assistant Postmaster General, Mr. Joseph Slater, MP, who has represented the Sedgefield constituency since 1950, is a former miner and was Parliamentary Private Secretary to the late Mr. Hugh Gaitskell and the present Prime Minister, Mr. Harold Wilson. Born in 1904, Mr. Slater is married and has one daughter and one son. He has been a Methodist lay preacher since 1932.

PUTTING THE COLOUR INTO TELEPHONES

by JOAN L. CRAFT

IN keeping with the trend for colour, colour, and yet more colour in homes an attractive range of coloured telephones is now available. There are nine colours: forest green; aircraft grey-green; elephant grey; light French grey; concord blue; topaz yellow; lacquer red; light ivory; and black.

These colours were selected from 250 specially produced models by the Council of Industrial Design. Despite the variety on offer ivory remains the most popular telephone. Four of these are sold to one of every other colour.

Currently the Post Office requires two million telephones a year and cases and handsets are made in acrylonitrile - butadiene - styrene (ABS). In its natural state, ABS comes in small white opaque pellets.

Colour is introduced into plastic by a process known as "dry mixing". Natural pellets and pigments are tumbled together until each particle of plastic is coated with a thin film of colour. This is then fed directly into an injection moulding machine.

By this method colour can be controlled by the moulder. He can adjust to any shade by varying the pigments used. Matching and maintaining a precise colour over long periods, however, does require considerable skill.

Though the responsibility for colour control lies with the moulding manufacturer, he is visited regularly by an officer of the Test and Inspection Branch who inspects the production. Since cases can be moulded at the rate of one a minute—and sometimes even faster—very frequent inspections have to be made to assure accuracy.

Especially among men, it is not unusual to find abnormal colour vision, consequently colour inspection specialists have to be very carefully selected.

One method of doing this is by the well-known Ishihara charts (used by the Armed Forces). These charts comprise areas of coloured dots in which the person with normal vision sees a number. If the person's colour vision is defective, he sees an entirely different number, or none at all. The most common disability is not being able to distinguish between green and red. Even those with normal colour vision can lack the ability to detect small variations in shade.

Mrs. M. Harridence, of the London Materials Section, uses a tristimulus colorimeter to measure the colour shade of a telephone case. The colorimeter defines colour in numerical terms.

A test devised by the Engineering Department, London Materials Section, detects this fault. It comprises a series of plaques in telephone colours varying slightly, and the test is to arrange them in order.

The delightful but unusual colours chosen by the Council of Industrial Design are not covered by any British Standard shade. The Test and Inspection Branch issues its own standards. These are used for judging production at contractor's works. Initially, flat plaques were used but now a case is compared with a standard case, and likewise, a handset with a standard handset.

When samples are visually examined to see if they match to standard, three main requirements

are needed: well lit surroundings; a neutral background; and a variety of light sources. Colour judgment is best when the level of illumination is high, as perception fades when the amount of available light decreases.

Different types of light sources are required for colour matching. By daylight two objects may match quite closely, but when seen by light from a tungent filament bulb, or a flourescent lamp, they may not match at all. This effect is known as metamerism. Home decorators sometimes experience it when they choose a paint to match a fabric in daylight. Later, when they switch on the electric light, they find there is a mismatch.

Many instances of this occurred with the 700 type telephone, where contractors attempted to make an auxiliary part to match the telephone mouldings. Usually another material, or another plastic was used for the auxiliary part, different pigments being used to obtain colour. Generally this problem can be overcome by using the same pigments for the auxiliary parts as used for the telephone mouldings.

As with all manufacturing processes, a number of variables are involved when injection moulding in colour. Pigments and natural polymer may vary slightly in shade. Slight inaccuracies may occur in weighing out the pigments. Different machines working at different rates may cause material to be heated longer in one machine than in another.

It is possible for all these things to have an effect on the final colour which means tolerance must be allowed.

From experience an inspector will know whether to accept or reject, but occasionally disagreement will arise because it is impossible to set precise visual limits. In such cases samples are referred to the London Materials Section. There, colour is measured on a photo-electric triatimulus colorimeter, and the readings converted to C.I.E. units.

The C.I.E. (Commissione Internationale d' Eclairage) system of colour measurement enables a colour to be completely defined in numerical terms, known as chromaticity co-ordinates, which specifies its hue and luminance factor.

Under this system, deviation from a standard can be expressed numerically. This, together with a visual assessment allows a decision to be reached in doubtful cases.

The procedure of measuring colour instrumentally is too lengthy to be used for normal production control, yet every care is taken to see a high standard of colour matching is maintained for the telephone instrument.

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A THANK YOU FROM THE RED CROSS

THE Chief Supervisor, Continental Exchange, London, has received the following letter from the British Red Cross:

On 4 August at 7 pm, Miss Hilliers, Head of our Invalid Travel Section, received an urgent request to bring to England the father of a young German youth on holiday with British friends in Lincolnshire. The immediate presence of the father was recommended by the local doctor in the hope of arresting a serious deterioration of a recurrent mental disturbance from which the son suffered.

All attempts to locate the father, who was on holiday in Holland, had failed. At 7.30 pm Miss Hilliers telephoned your Continental Service, gave the operator a brief outline of the case and supplied the names and addresses of a few people in Luneburg, where the father normally lived, who might help.

Within minutes your operator made contact with Hamburg who telephoned the Luneburg Police. By 7.45 pm Luneburg Police found the father's deputy and by 8.30 pm Miss Hilliers was speaking to the father in Holland, and able to confirm to the host in Lincolnshire that the father was departing immediately for England.

This was entirely due to the understanding, sense of urgency and sympathy with which this request was relayed . . . and we would like to convey our sincere appreciation of the magnificent service given. . . . If possible we hope you may also be able to extend our thanks to "Miss" Hamburg and to the Luneburg operator.

Our Invalid Travel Section get many such calls and Miss Hillier has also asked me to mention the unfailing help given by the Continental Service, though the call on 4 August will be remembered as one of the most outstanding examples.

Successful trials have been carried out in the Engineering Department with a new system of training called programmed learning in which machines replace the human teacher and the students learn stage by stage from frames of questions and answers

A NEW TECHNIQUE IN TRAINING

By G. H. KIMBER
and H. E. SMITH

THE Post Office, with other Government departments and many local education authorities, is taking an active interest in the possible benefits of programmed learning—a new technique of training which may solve some of the problems facing educationists today.

Programmed learning lends itself most readily to training of a technical nature and has already been tried in a few simple experiments at the Central Engineering Training School. As a major effort one of the Engineering Department correspondence courses, dealing with a complete year's work in a City and Guilds Telecommunication subject, has been written in this form and used for instructional purposes during the past session. It proved to be a Herculean task on the part of printers and typists, as well as authors. Fortunately, however, the students were ready by examination date.

Throughout the country, some 500 students enrolled for the subject — Telecommunication Principles A. In order to compare programmed learning with the more orthodox method, half the students were supplied with the new course and the results achieved by both methods were found to be almost identical.

The average mark of those using the old course was fractionally higher (10.5 compared with 10.3),

The Empirical Tutor, one of several teaching machines now available, in use at the Sales Training School of Lampson Technical Products.

but the average total mark per paper was the same (60.3) indicating that there may have been a tendency for the students using the programmed course to attempt more questions. The majority of these students expressed a preference for this type of course, despite the increased amount of reading material.

Experienced programme writers invariably find that their first efforts require considerable alteration before the best results are obtained. It is therefore encouraging to find that the new course has proved at least as good as the old and, following the first trial, it is certain to be more effective in future years, when necessary amendments have been made.

While the exact process of learning will always provide material for debate between teachers and psychologists, certain principles are now generally accepted, one being that no one can learn for a student. That he will do so more effectively if allowed to learn at his own pace, is also agreed. Furthermore, when the student is tested at frequent intervals the best results are achieved; this decides whether he has fully understood the material and if not, instruction can then be reinforced.

Programmed learning presents the student with information in small sections, known as "frames". These are arranged in logical sequence. The actual teaching process is by question and answer based on the frame material. Students also learn to read effectively as an incidental part of this training, which was introduced in its present form some 10 years ago by Professor Skinner of the United States. His particular system is known as "linear" programming.

About the same time his fellow countryman, Dr. Norman Crowder, was investigating the training needs of aircraft service technicians and in doing so developed what is now known as "intrinsic" or "branched" programming. Britain was also represented in this field by electronics engineer, Gordon Pask, who was exploring the problems of teaching manual skills at the University of Illinois. As a result of his work, machines were produced which adapted themselves and amended their programmes to the performance of the student. Machines of this sort are still in the early stages of development, and still very expensive.

With the Skinner system of linear programming, material is broken down into small steps which lead the student in a logical sequence through the subject. With each increment of information the student must respond by adding missing figures or words to the text frames, the important feature being that the student must write down or "construct" his responses.

To avoid errors the steps need to be gradual. In a well-written programme the percentage of correct answers at each stage should be higher than 95 per cent. In this manner a student can see if he is right or wrong, and the more often he makes the correct response the greater will be his interest and enthusiasm.

The branched, or intrinsic, programme developed by Crowder uses the responses of students to decide whether they should follow the normal frame

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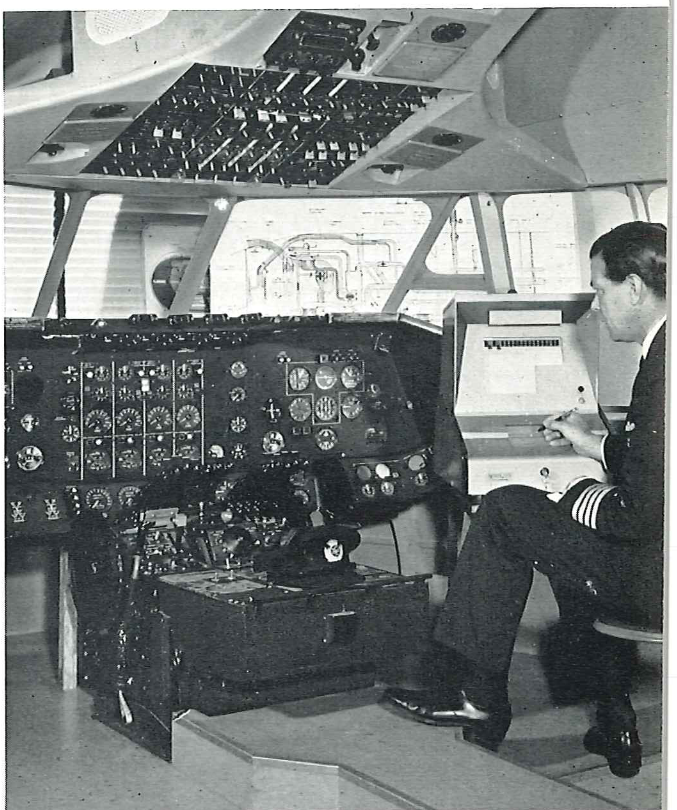


A British European Airways pilot using the Empirical Tutor in conjunction with aircraft control equipment at BEA's Flight Operations Department.

A NEW TECHNIQUE IN TRAINING *(Contd.)*

sequence. This is done by means of multiple choice question and answer technique. If the correct answer is selected, the student proceeds to the next logical frame, but otherwise he continues on an alternative branch which presents the same material again in easier steps.

In normal circumstances 85 per cent of the students should select the right answer, but with this system there is a possibility that the student may guess at the answer, and by chance press the right button. The latest tendency, therefore, is to ask a specific question at the end of each frame without alternative answers. If the student answers correctly he carries on with the next normal frame. If he is wrong he is taken as before to the first of a series of remedial frames.

Since programmed learning depends largely for its effectiveness on the question and answer technique it is necessary to have some device, controlled by the student, which presents information in correct sequence and also poses appropriate questions. The student must be told at once if his answer is correct, and preferably he should not be able to cheat. A number of such devices—teaching machines—have been produced. They fall mainly into two categories—those which require a constructed response from the student, and those with facilities for multiple choice answers.

The machines using linear programmes are normally very simple mechanically, the programme being printed on a roll of paper which can be wound past a viewing aperture in the machine. The student's response is written on a separate strip of paper which is moved forward at the same time as the programme. In addition it has a non-reversible drive which prevents any cheating by the student. The most elaborate machine of this type can operate auxiliary equipment such as a film strip projector, cathode ray oscilloscope, tape recorder, and so on.

More expensive machines are generally required for branched programmes since the frame sequence will depend on the answer chosen by the student. The programme is usually recorded on film strip and the frames projected on to a ground glass screen. The student has to select one of several given answers to the set question and he does this by pressing the corresponding button on the machine. If the answer is correct the next frame says so and continues with the next item of information. If the student makes a mistake, however, a different frame appears, tells him where he went wrong and instructs him to press the button which returns the original frame.

It is not always possible for students to have access to one of these machines, and as a possible alternative this new method of instruction has been used in textbooks produced by the English Universities Press. These are called "Tutor Texts" and use the branched type of programme.

Each frame of information ends with a question and multiple choice answers and the reader is told to turn on to a certain page of the book depending on the answer selected. The "Tutor Text" thus works in the same way as a much more expensive teaching machine—the only disadvantage being that it is not cheat proof.

A number of educational bodies in this country, including the Royal Air Force and the Admiralty, have carried out carefully controlled tests using programmed instruction in comparison with orthodox methods, with most encouraging results. For example, Admiralty tests showed that students using a teaching machine covered the syllabus in less than half the time taken by those taught in the usual manner by an experienced teacher, and subsequent examination results were almost identical.

Programmed instruction, allied with suitable teaching machines, can be of great assistance in many different situations: where few teachers are available; where students are geographically isolated; where small industrial firms cannot afford an organised training scheme; where students work irregular hours; where more elderly officers would suffer a loss of dignity by going to classes with junior members of their staff.

It is not intended that the new technique should operate without the adaptability, enthusiasm and guidance of a teacher, but to quote a well-known psychologist, "Any teacher who can be replaced, deserves to be replaced."

THE AUTHORS

MR. G. H. KIMBER, BSc, ACGI, AMIEE, is a Senior Executive Engineer in the Training Branch of the Post Office. He joined the department in 1936 as a Probationary Inspector in Research Branch.

MR. H. E. SMITH entered the London Telecommunications Region of the Engineering Department in 1938 as a Youth-in-Training. In 1955 he was promoted to the Training Branch of the Engineering Department as Assistant Engineer.

Telephonist trainees at Ipswich try out different forms of presenting programmed information.

TRYING IT OUT ON TELEPHONISTS

By C. HALL and R. N. FLETCHER

THE pattern of initial training of telephonists has been altered by the Ray Supervision and Training Scheme† from centralised to local training in the exchange in which the new telephonist will work.

An Assistant Supervisor in what amounts to a conventional tutorial relationship now trains the recruits in pairs. This training consists of two main elements: instruction in operating procedures and practice in applying procedures; instruction being interspersed with practice.

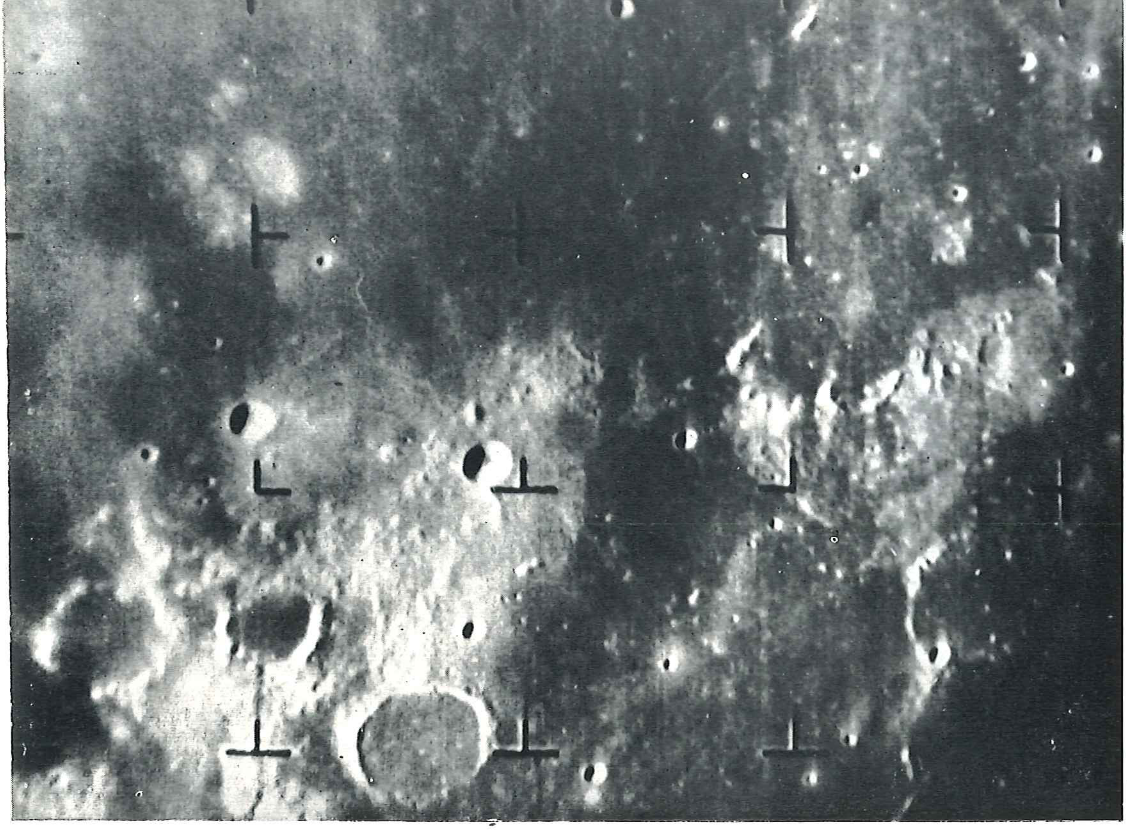
Experience in other fields suggests that programmed learning can, with advantage, be adopted in conjunction with local training under the Ray Scheme. At this stage it looks as though 20 or so separate programmes will be needed to cover initial training, each dealing with a particular aspect of the course. The present rough breakdown, which may need to be modified in the light of further experience in designing the programme is:

*Introduction to the Telephone System.
*Use of the VIF.
*Explanation of call charges.
General aspects of booking of calls and ticket preparation.
Speaking to customers—courtesy, expressions, pronunciation, letter analogy.
Timed calls from ordinary lines (Part 1).
Timed calls from ordinary lines (Part 2).
Pay on answer coinbox calls.
Long duration calls; ADC requests.
Difficulties (Part 1)—Number engaged, No reply calls.
Difficulties (Part 2)—No lines, No tone.
Difficulties (Part 3)—Wrong number, Cut off.
Difficulties (Part 4)—Number unobtainable, Originator engaged, Originator no reply.
Assistance calls from STD customers.
*Personal calls (Part 1).
*Personal calls (Part 2).
*Personal calls (Part 3).
Calls from prepayment coinbox lines.
Calls from prepayment coinbox lines—difficulties.
Incoming calls.
Credit card and transferred charge calls.

Draft programmes have now been written for those sections marked with an asterisk and are being tested at four centres: Birmingham; Leicester; Ipswich and Southend. The first stage of the testing, now nearly completed, has been in the nature of an exploratory exercise to test their acceptability and adequacy. The next stage will be to revise and reproduce the programmes in machine and book form for a field trial under working conditions in the same four centres. As soon as the first two programmes reach the field-trial stage a start will be made on further programmes.

The results so far have been encouraging and seem to justify optimism for this new technique not only in initial training but also in other aspects of operator training.

†See Winter, 1963, issue of the *Journal*.



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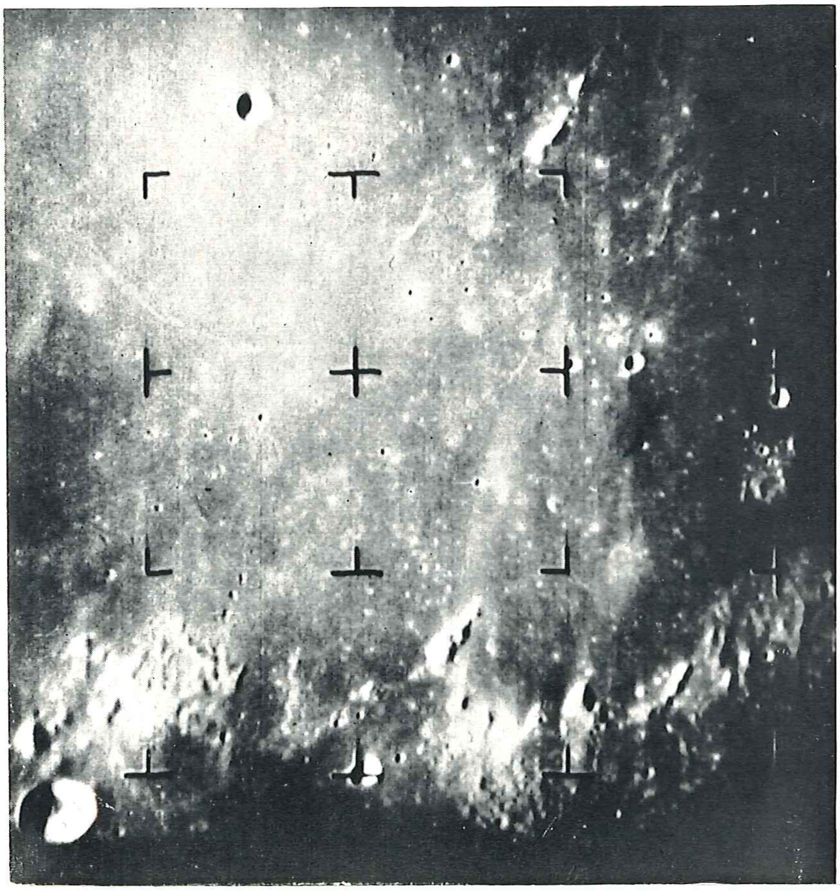

RANGER'

THESE remarkable close-up p many hundreds sent back to e the United States spacecraft ***R*** **into the Sea of Clouds in the ear**

Until now man has not been able than a quarter of a mile in diamete *Ranger VII's* pictures—taken as the s at 4,000 miles an hour—show objects

Ranger VII, which was launched to complete its 243,655-mile journey suggesting that when man lands on landfall. Its pictures revealed that the pock-marked with small saucer-like c in dust only a few inches deep. So m that space ships would disappear bene

Ranger VII's astonishing journey— is a giant stride towards the day when step will be taken next year when *Sur* due to make a soft landing to pick up s them and radio the results back to ear

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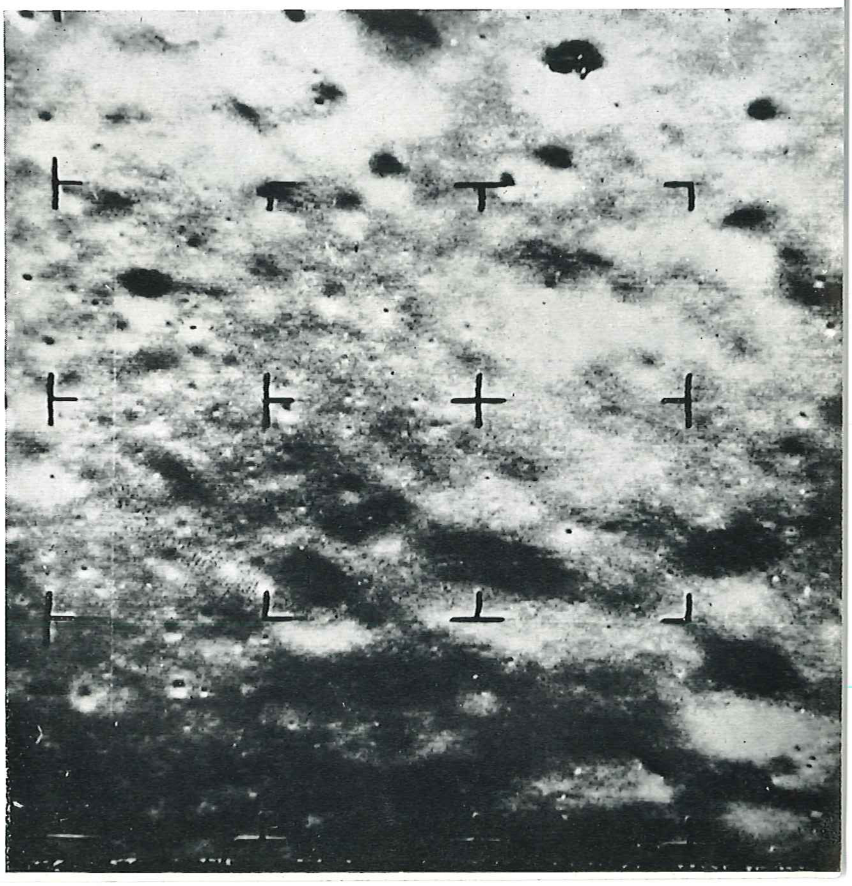
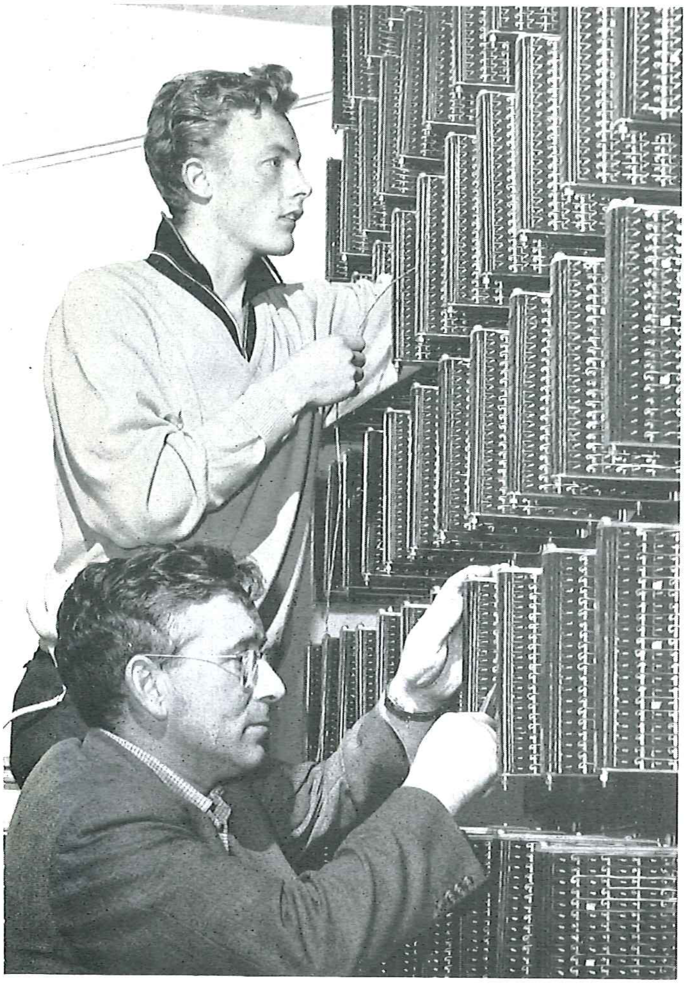


ictures of the Moon are four of arth by the television cameras of *anger VII* just before it hurtled ly hours of 31 July.

to see anything bigger on the Moon r and that only through a telescope. pacecraft travelled to self destruction as small as 20 feet across.

from Cape Kennedy, took four days to the Moon and sent back evidence the planet he can expect a smooth Moon's surface is gently undulating, aters a yard or so across and covered ich for those scientists who predicted th quicksands of mile-deep dust drifts. -she landed exactly where intended— man sets foot on the Moon. The next *veyor*, another American spacecraft, is samples of rocks, automatically analyse th.



ULSTER VOLUNTEERS AT HARWELL

By T. MURPHY

A team of over 40 men from the Belfast Area went to the Atomic Energy Research Establishment at Harwell when Oxford Area found it was unable to take on the telephone project there. It was a first-class example of inter-area co-operation

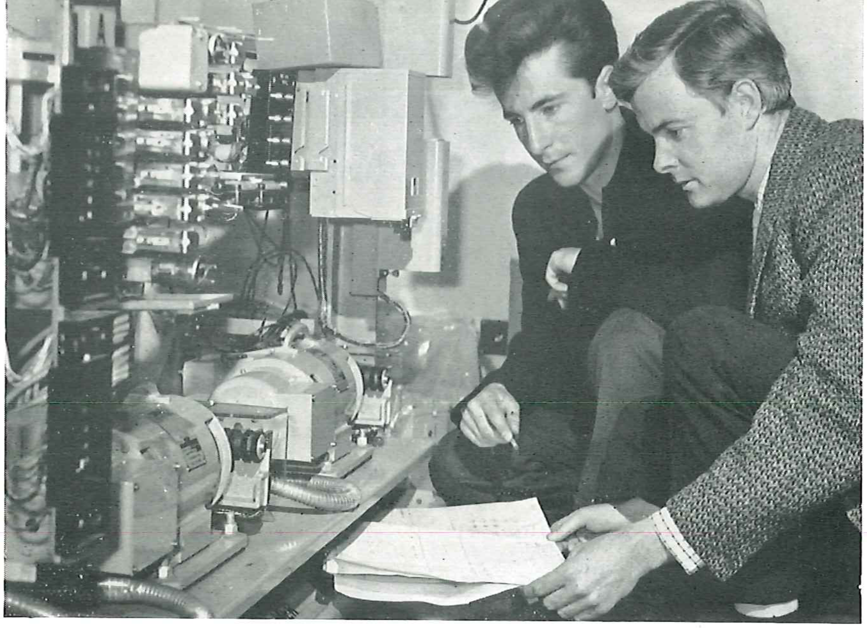
Technical Officer McClintock (top) and Technician Mehaney at work on the MDF equipment.

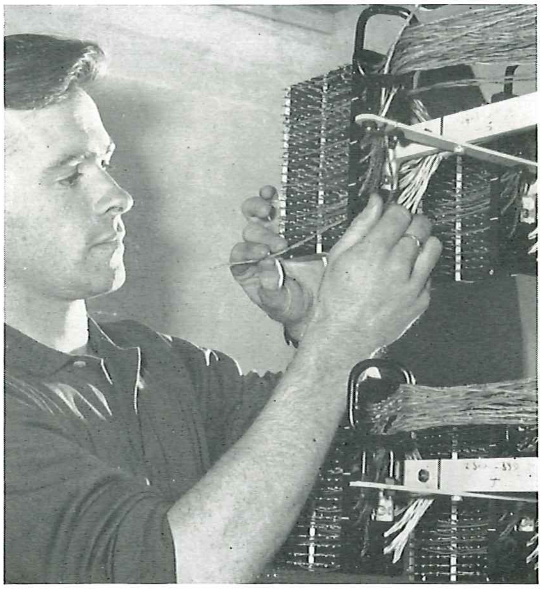
WHEN a new private automatic branch exchange comes into service at the Atomic Energy Research Establishment at Harwell, in Berkshire, in December it will be due in large measure to the efforts of a team of Post Office engineers and workmen from Northern Ireland.

The story—one of close co-operation between two telephone areas—goes back to August, 1963. The Atomic Energy Research Establishment decided to replace its old-fashioned PABX, on which all outgoing calls had to be routed through the switchboard operator, with a modern PABX. The contractor would install the equipment ready for Post Office tests and Post Office staff would be needed to re-wire all extensions, change all the instruments, provide an extensive local line network and carry out acceptance tests.

Unfortunately, the Post Office staff in the Oxford Telephone Area, in which Harwell is situated, was already hard-pressed with other urgent jobs and could not take on this additional commitment. Happily, however, a way out was found when the Belfast Telephone Area agreed to take over the work. First, an advance party consisting of an Assistant Engineer from Londonderry with eight

Technical Officers W. H. Tollerton and W. R. McCusker, both from Belfast Area, test the ringer bay at the main Harwell Exchange. Right (below): Technician T. Kirk adjusts the MDF "jumpers".





fitters from Belfast arrived in Harwell early this year. Later, others followed until by the summer the Belfast team—all volunteers—was 42 strong: the Assistant Engineer, an inspector and 40 internal and external workmen.

The new installation at Harwell, which consists of one main exchange and two satellites, provides a combined multiple capacity of 2,500 lines. The system of satellite working will reduce the length of lines and, therefore, the cost of rentals for extensions on the further reaches of the site. This layout, which was planned by the Oxford Telephone Area, allows the line plant on the site to be developed without greatly increasing the cost since existing cables can be used for junctions between satellites and the satellites themselves can be developed by using shorter lengths of new cable to augment the existing cable.

Extension telephones are of the 700 type equipped with recall facilities. Telephones needed in the radiation hazard areas have been fitted by the Atomic Energy Research Establishment staff, trained by the Post Office.

The operation at Harwell has involved installing 102 apparatus racks and the complete installation is equivalent to the exchange serving Londonderry, Northern Ireland's second biggest city, and appropriately the home of a large number of the Belfast Telephone Area staff who crossed the water to give Oxford Telephone Area a helping hand.

During their stay in Harwell the Belfast Telephone Area staff were accommodated in the Atomic Energy Research Establishment's hostels and competed against the AERE in a keenly fought seven-a-side soccer match. The Oxford Area had high praise for the help and co-operation received from the Belfast Area. The Harwell project was completed over a month ahead of schedule in a most efficient manner and a minimum amount of call upon the Oxford resources.

The appearance of Belfast vans in Oxford caused much local comment and an illustrated article was published in a local newspaper.

The Director General looks into the future.

LOOKING AHEAD TO 2024

★

WITHIN the next 60 years the number of telephones in Britain will have increased five-fold and the number of calls may reach ten times the present figure of 15 million a day.

Telephone service will be "built" into houses as they are erected and combined with television and sound radio services . . . there will be television telephones on which subscribers will be able to obtain the numbers they want by pressing a single button . . . hundreds of thousands of channels may be provided by special amplifying devices and much of the present-day equipment may be replaced by miniaturised apparatus needing no maintenance . . . computers will revolutionise the communications services.

These were some of the developments foreseen by the Director General of the Post Office, Sir Ronald German, CMG, when he recently addressed the Post Office Telephone and Telegraph Society at the opening session of its Diamond Jubilee Year.

After briefly reviewing the technical and social advances which have been made in the past 60 years, the Director General said he did not intend to emulate Jules Verne and paint a fanciful picture of the future, but rather to make an intelligent judgment based on what had already been achieved and what research scientists were developing now.

"The telephone service in 1964 bears little resemblance to that of 60 years ago," he went on. "It is true that we still have some 500 manual exchanges serving 10.5 per cent of subscribers, but there the resemblance ends. We now have nine-and-a-half million telephones and are handling 15 million calls a day. Not only can our customers speak to one another quickly and with certainty but they can also talk if they wish to telephone subscribers throughout the world.

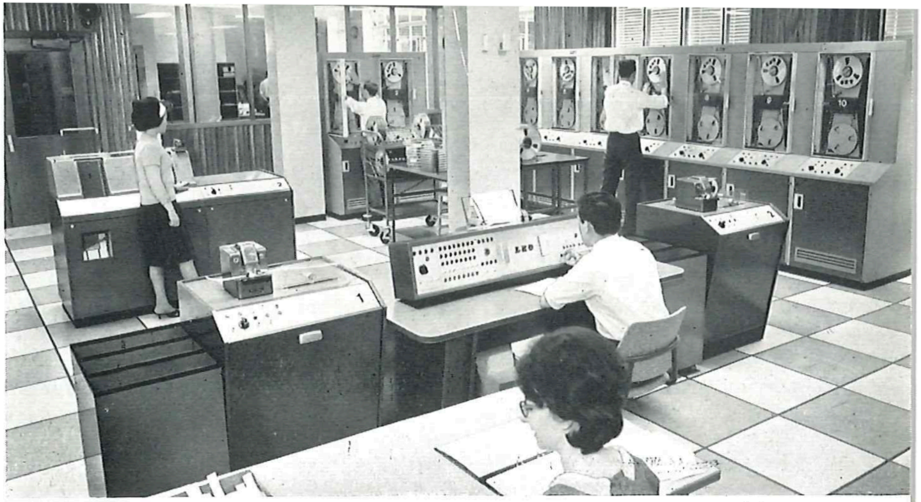
"Until 10 years ago all inter-continental telegraph and telephone communication was by radio in the lower frequency bands and telegraph cable. With the development of much more reliable components the installation of amplifiers in submarine cables became possible and now there are four cables across the Atlantic alone providing nearly 400 telephone channels. There are submarine telephone cables also in the Pacific and the world network is being expanded very rapidly indeed. . . .

"All this spectacular development has been based on the discoveries of Sir Ambrose Fleming which led to the development of the thermionic valve. Neither our long-distance internal system nor the overseas expansions would have been possible without the amplifying valve

"We are handling about 15 million telephone calls a day. Technical advances in this field have been almost continuous. We are now building a radio network in the United Kingdom centred on the Post Office Tower in London which will provide tens of thousands of telephone channels.

"Now let me turn to the future. What sort of world will our grandchildren be living in in the

"We are only beginning to realise the possibilities which the computer opens up." This is the computer room at Charles House where a new Leo computer is handling telephone accounts for part of the London area.



21st century? . . . The population of the world is increasing more rapidly than at any time in our history and in 60 years time in the United Kingdom alone we shall have 80 million people compared with 54 million now. If, as I believe, our scientists solve the problem of feeding this vastly increased world population, we must see an ever-improving general standard of living as we take full advantage of scientific and technological developments. . . . It is against this background that all my forward thinking must be judged.

"It is easy to deduce that with a population of 80 million we shall have some 25 million households. And in 60 years time I am sure that telephone service will be provided to new houses as they are built much as electric power is laid on now. It is easy, too, to predict that if no spectacular changes in facilities are developed our business customers will be more numerous and require more telephones. If, as I believe, there has been by then a considerable re-shaping of the industrial pattern of the nation and people have become more mobile they will find a greater need for telephone communication. **I expect that in the United Kingdom there will be some 25 million exchange lines and between 40 and 50 million telephones. The number of calls might well reach 150 million a day.**

"Spectacular developments are taking place already which suggest a different pattern of communication. . . . The invention some years ago of the transistor, which can serve the same function as the thermionic valve, is probably as significant as the discovery of the valve itself was 60 years ago. Even the first transistors were small in comparison with the valve, but **we are now making at Dollis Hill transistors so small that they are difficult to see with the naked eye.** It is the increasing variety of electronic components which is opening up so many exciting possibilities not only in the communications field but also in industry generally.

"In the international field," went on Sir Ronald, "I believe that because of the development of world resources there will be an enormous demand for communication. In the last 10 years we have seen not only the installation of thousands of miles of submarine telephone cables but the successful launching of communications satellites. . . . Next year we shall see the launching of the first satellite designed to provide large capacity telecommunications across the Atlantic and none can doubt that before long a system or systems of satellite communications will be established.

"While this will augment existing facilities it will open up the possibility of multiple communications to the more remote parts of the world far removed by oceans. None of this would have been achieved without a higher degree of reliability than had recently seemed possible. **We are now building components with almost indefinite life and while reliability is essential if we are to place equipment in space where maintenance would be impossible, the same technique might enable us to build telephone equipment for use in our internal service which can be sealed and need no maintenance for the whole period of its economic life.**

"In our internal system," prophesied Sir Ronald, "we shall be able to think in terms of small packets of equipment, perhaps installed underground, forming part of our whole network and offering many more facilities than we can provide at the moment.

"If our system expands as I expect, we shall require enormous numbers of circuits between

OVER

LOOKING AHEAD TO 2024 *(Contd.)*

main towns and **already there are possibilities of hundreds of thousands of channels being obtained by using hollow tubes with amplifying devices at frequent intervals guiding radio waves to their destinations.**

"Technical developments already in mind are likely to be developed within the foreseeable future which will produce great increases in capacity available for communications and this will cater not only for speech and television but also for what is already becoming of increasing importance—the transmission of information."

After commenting that computers are already being used to perform many routine clerical processes, the Director General continued, "Although this is an obvious use and the Post Office is installing computers to prepare telephone bills and has plans to computerise much of its routine work, there are other and perhaps much more important uses to which these machines can be put. . . . We are only beginning to realise the possibilities which the computer opens up. Management will be able to have more quickly than ever before comprehensive information about the state of its business, how sales are going, what type of article is being sold, and so on, and this information will almost certainly be collected over telecommunications links."

In the Post Office it would be possible for counter clerks to record in machine language on tape every transaction and for this information to be sent during the night to computers, say at Regional centres, so that by next morning all the information would have been processed and recorded. All savings accounts would be up-to-date and the Comptroller and Accountant General would be able to present full accounts of the

This new and more compact telephone will soon become available to subscribers. It has an illuminated dial and gives a tone calling signal.

previous day's transactions. . . .

"In the last few years, because of the vast increase in our telephone construction programme, we have on occasion not had sufficient stocks of individual items to ensure a constant supply to all areas. . . . **We shall certainly in future have all our stores records and processes computerised and centralised control will be simple and, I hope, stock holding would be reduced.**

"Already we can see the beginning of a new type of service. We are making available to our customers services to permit the exchange of information at differing speeds to meet the needs of small and large firms. Computers are costly but facilities for sharing them are being developed and some manufacturers hire out time on the machines. It is not too much to expect that **within 60 years the amount of information transmitted over our telecommunications system in machine language will exceed the volume of spoken words.**

"This suggests that we may find it necessary to provide a separate network of wide-band circuits to provide not only for individual companies to collect information for themselves but to provide also for inter-connection between computer circuits. **The Post Office might find itself offering a computer service to customers on much the same lines that it offers a telex service today.**

"One thing is clear. Telecommunications engineers, by using techniques already established, will be able to provide all the channels which any of these services require and in greater numbers. And this can be said not only in the internal field but in the overseas areas, too. Thanks to the amplifier distance is no longer the obstacle it was. . . .

"In 60 years time possibly two-thirds of our telephones will be in private homes. What sort of service will we be offering ?

"I suppose the telephone instrument will be much the same as it is today. . . . Those who wish will be able to have instead loud-speaker telephones and probably television telephones showing the person making the call. Almost certainly the dial will have disappeared and there will be some form of press-button arrangement. We shall just about have replaced all the electro-mechanical equipment. We shall certainly be able to be connected directly to most of the numbers throughout the world, even though we may have long series

of digits to contend with and all digits will be numbers. The exchange name will no longer have any significance. Most people will have some device rather like a permanent address book which will store numbers they frequently use and signal the required number at the press of a single button.

"Surely, just as by then most families will have two cars, with perhaps a mobile telephone in at least one of them, **a large number of ordinary homes will have some inter-communication system and many homes will have more than one exchange line** if only because children will have become more independent. Separate telephones will perhaps become a prestige symbol. It will almost certainly be possible to switch on the central heating in the country cottage by means of a telephone call. . . .

"Directory information with a system of this size presents special problems. In the United States, where they have more telephones now than I forecast we shall have in 60 years time, the Bel Company still provides directories to all their customers about once a year. Let us not, therefore, believe that it would be impossible to maintain a directory service.

"All directory information will, I believe, be stored on magnetic tape in a number of computers and direct access given to an operator who might be able to have displayed before her on a panel the number she is seeking. This would at least solve the problem of operators at Directory Inquiry positions having to look manually through the pages of printed directories. This problem must be solved because if we do no better than at present we shall need more operators in 2024 dealing with directory inquiries than we have in the whole of our system now. . . .

"It is possible to visualise great changes in the pattern of telephone exchanges. We may have many more, even to the extent of small switching units buried with our underground cables. We may, on the other hand have far fewer, depending on the economics of line plant provision. . . .

"One of the extraordinary developments in the past 10 years has been the growth of television in the United Kingdom and we shall have colour television quite soon. Already 90 per cent of all our homes have at least one television receiver—many more than have telephones. Can we believe that in a country which prides itself on improving the amenities of our towns and cities we shall tolerate for ever the unsightly array of television

The Post Office Tower in London is a visible sign of the future system which will provide tens of thousands of telephone channels.

aerials? It is a strange commentary on our sense of values that in areas where people are prepared to pay part of the cost of putting telephone wires underground we see two, three and now, at times, four aerials on every house. We must find some way of combining these two services. . . .In Holland in some areas the telephone people run in with their telephone cables special pairs to cater for television and sound broadcasting. They have also developed a small coaxial cable for the same purpose. I am not prepared to say which of these is the better or whether something different will have to be developed, but **I am convinced that in the next 60 years the distribution of telephone, sound and television services will be combined.** Such aerials as remain, except in rural areas, may be distributed on community aerials receiving broadcasts direct from satellites. . . .

"I am also sure that completely new facilities will be developed which at the moment we cannot visualise.

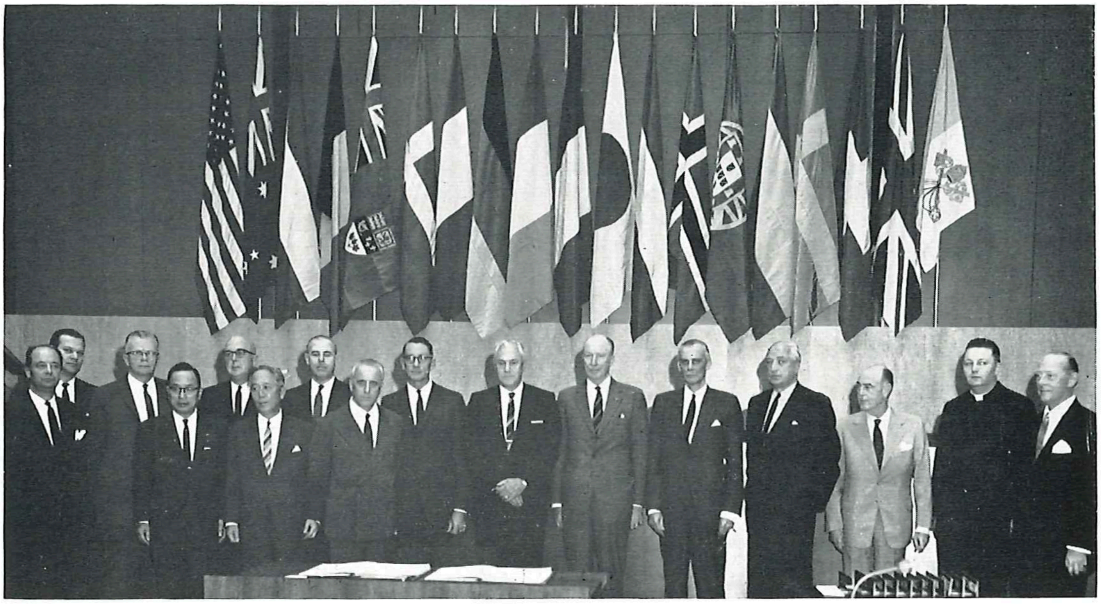
"The pattern of our system must change and our organisation be modified to meet the changing circumstances. If, as I hope, the technical developments lead to a reduction in cost we may and probably will find telephone service becoming progressively cheaper compared with other services. . . . It may be that we shall see a much simplified tariff structure."

Finally, Sir Ronald emphasised that the Post Office must play its part in developing the character of future society and always be ready to meet the needs of planners in fields other than its own.

"We have a duty to keep abreast not only of public needs but also public desires. In the immediate future our main task must be to overtake the backlog of demand. Once we have done this we must keep abreast of the current requirements of our customers—even ahead of it."

SETTING THE SEAL ON THE SATELLITE PACT

By A. G. SMITH



Representatives from Britain, the United States, Australia, Canada, Denmark, France, Italy, Japan, Netherlands, Spain and Vatican City during the agreements signing ceremony in Washington.

"Desiring to establish a single global commercial communications satellite system as part of an improved global communications network which will provide expanded telecommunications services to all areas of the world and which will contribute to world peace and understanding."

THUS runs a second recital of the agreement establishing interim arrangements for a global commercial communications satellite system which, together with a "Special Agreement", was signed in Washington on 20 August, 1964.

The signing of the agreements was the climax of intensive international discussions.

A Commonwealth Conference on Satellite Communications was held in London in the Spring of 1962. The Conference emphasised that any communications satellite system should cover as many countries as possible and that there should be the fullest degree of co-operation with the United States.

Later that year a special meeting of the Telecommunication Committee of the Conference of European Postal and Telecommunication Administrations (CEPT) was held in Cologne to discuss satellite communications and since then various Committees of the CEPT have given a great deal of attention to the subject.

In 1962 significant developments also took place on the other side of the Atlantic when the United States Congress passed a Satellite Act. This Act declared that it was the policy of the United States to establish as expeditiously as practicable, in conjunction and co-operation with other countries, a

commercial communications network which would be responsive to public needs and national objectives. It would serve the communications needs of the United States and other countries and would contribute to world peace and understanding.

May 1963, saw the creation of a European Inter-Governmental Conference on Satellite Communications to harmonise European views and to undertake discussions with the United States and other countries.

This Conference at its first meeting agreed that satellite communications should be organised on an international basis to enable European countries to participate in the design of the system; to share in its ownership; to play a full part in its management and to have an opportunity as the system expanded and developed to provide satellites, launchers and other equipment.

The general view that satellite communications should be organised on a broad international basis stemmed from the fact that satellites can, in principle, provide many simultaneous connections to countries all over the world, and are most economical when used in this way. This greatly assisted the course of negotiations involving many countries and various interests in each of them. For instance, in Britain, the Foreign Office, and the Ministry of Aviation, as well as the Post Office, were intimately concerned.

The two agreements which were signed in Washington in August are, of course, closely inter-related. Their separation was necessary due to the differing arrangements in individual countries for the control and operation of telecommunication services. The first agreement is between governments. It sets out the general objectives in the field of satellite communications and the conditions which shall apply, and it establishes interim arrangements for a global system.

The second is an operating agreement between telecommunication entities covering financial and technical provisions, and was signed by Sir Robert Harvey on behalf of the Postmaster General.

The agreements are designedly of an interim character to cover the next five years or so. The intention is that they will be superseded by definitive arrangements not later than 1 January, 1970, to be determined in the light of experience. The full texts of the agreements are embodied in the White Paper on Satellite Communications (Cmd 2436); only a brief resumé of the more important provisions is given here.

The agreements are concerned with what has become known as the "space segment", that is, the communication satellites and the tracking, control, command and related facilities required to support their operation.

Sir Robert Harvey, formerly Deputy Director-General of the British Post Office, signs one of the Washington agreements.

The responsibility for the design, development, construction, establishment and operation of the space segment is vested in an International Committee comprised of one representative from each country, or group of countries, whose contribution to the estimated cost of 200 million United States dollars is not less than 1.5 per cent.

Britain's share of the costs will be 8.4 per cent or £6.0 million spread over a period of about five years. These payments will be made from the Post Office Fund and the British representative on the International Committee will be either the Director or the Vice-Director of External Telecommunications. The Committee's seat is in Washington.

The US Communications Satellite Corporation will act as manager of the space segment and will carry out the general policies and directives of the International Committee.

OVER

SATELLITE *(Contd.)*

When proposals or tenders are comparable in quality, price and time of performance, the International Committee will seek to ensure that contracts are distributed between member states in approximate proportion to their respective financial contributions.

Facilities in the space segment will be rented to all users at rates of charge which will be determined by the International Committee and which, in general, will cover costs and ensure an adequate return on the capital employed. The income, after meeting operating, maintenance and administration costs, will be distributed to members in accordance with their contribution to the costs.

These, in outline, are the main provisions of the agreements which were signed in August by Britain, the USA, Australia, Canada, France, Spain, Norway, Vatican City, Denmark, The Netherlands, Italy and Japan, and which are open for signature by all states which are members of the International Telecommunication Union.

How soon will the agreements be translated into reality? If all goes well, very soon. The plans are:

the launching, over the Atlantic Ocean, in March 1965, of a high altitude satellite. This will be a so-called stationary or, more precisely, synchronous, satellite (some 22,000 miles above the earth's surface). It will provide a maximum of 240 telephone circuits and it is hoped that after a short experimental period it will be used for commercial purposes;

the establishment of succeeding phases employing satellites, of types to be decided by the International Committee, with the objective of achieving basic global coverage in the latter part of 1967.

In essence, a satellite system will do exactly the same as is already done by high frequency radio and submarine cables; it will provide circuits from one place to another. It will have to be integrated with other means of communication; depending on the distribution of earth stations, a message may well be sent part of the way by cable and part by satellite.

Terrestrial networks will be used to carry the traffic to and from the earth stations and so satellite communications should be thought of as part of the whole complex of modern telecommunications facilities. Indeed, a customer in the UK making a call to, say, the USA, will be likely to be unaware whether his call is being transmitted by cable or by satellite.

As already mentioned, the international agreements are concerned with the "space segment". The "earth segment"—the earth stations themselves and the land networks—are outside their scope. Because the "space segment" cannot exist by itself, much thought will now have to be given to the earth segment arrangements.

These arrangements will no doubt vary from one part of the world to another and there are various possibilities. In some regions, ground stations may be owned nationally; in others, they may be owned jointly by a group of countries. In some cases, countries which do not own earth stations may lease circuit capacity in stations owned by other countries or, on agreed terms, they may be granted an "indefeasible right of user", that is, a long-term right to use facilities.

In Europe, it has been agreed that traffic via the synchronous satellite to be launched in 1965 will be transmitted and received by British, French and German earth stations in weekly rotation and that an interconnecting network between London, Paris and Frankfurt will be used for the distribution of the traffic. The Italian earth station will also take part. The permanent arrangements may well depend to a large extent on the type of satellite system which the International Committee chooses.

Undoubtedly the advent of satellite communications will attract a good deal of attention and perhaps excitement during the next few years, but considering that TAT-1—the first Trans-Atlantic Telephone Cable opened a mere eight years ago—is now taken for granted, it is not difficult to foresee the day when satellite communications will be regarded in much the same way.

THE AUTHOR

Mr. A. G. SMITH is a Principal in the External Telecommunications Executive, Satellite Communications Branch. From 1959 to 1963 he was the Official Side Secretary of the Engineering, Factories and Supplies Departmental Whitley Council.

The Late Mr. John Darke, CBE

His many former colleagues and friends will join the Journal in offering sympathy to Mrs. Darke on the recent death of her husband, Mr. John Darke, CBE, a one-time Director of North-Western Region.

The late Mr. Darke, who had been seriously ill for the past six years, joined the Post Office in 1912 and during World War Two, as an Assistant Secretary, held a key post in defence communications.

THE AERIALS WENT BY AIR

Courtesy, Western Mail and Echo.

THREE large horn paraboloid radio relay aerials, each weighing 17 cwt, had to be installed at the lattice towers at Wenallt, near Caerphilly, and at Llanllawddog, near Carmarthen, to fit into a chain of permanent microwave links which the Post Office is providing to increase television distribution in West Wales.

The problem was how to get them there since both sites are inaccessible by road.

Then someone had a bright idea. Why not use a helicopter? So it came about that one day in June the only available helicopter big enough to lift the aerials—an American machine on licence to the Central Electricity Generating Board—landed on Caerphilly Mountain where the aerial to be lifted to Wenallt had been taken as far as possible by road from the makers at Southampton.

The first stage of the operation went without a hitch as the helicopter took off from the top of Caerphilly Mountain and bore the first aerial to the Wenallt tower, some two miles away and 750 feet above sea level. The helicopter then flew on to Carmarthen where, in the car park of the Post Office Telephone Engineering Centre, two more aerials had been delivered for the Llanllawddog tower, about eight miles away over open countryside.

Then came mishap. As the helicopter rose to 300 feet, the first of the two aerials came adrift and crashed into a hayfield. However, after the helicopter had been put through a series of tests and the lifting site had been removed to the village of Peniel, some six miles from Llanllawddog, the second aerial was flown to the tower site. Meanwhile, arrangements were made for a replacement aerial to be rushed by road from Southampton and this, too, was lifted to the tower without incident.

The three aerials, which were subsequently winched into position on their towers, can carry several simultaneous television transmissions in the 6,000 megacycle band and one was used by the BBC during the General Election.

The Wenallt aerial will focus both the BBC national and ITA Welsh programmes on a similar aerial already installed at Werfa, about 16 miles away at the head of the Rhondda Valley. From Werfa the transmissions will be beamed over the hilltops to the Llanllawddog tower where they will separate—the ITA transmissions being beamed a further 19 miles to the transmitter at Foel Drych and the BBC service to two transmitters, one at Haverfordwest, 28 miles away, and at Blaenplwyf, 32 miles off, by way of another relay station at Mynydd Pencarreg.

Ticketing Telex Automatically

By S. R. V. PARAMOR

AN outline plan for the progressive introduction of a fully automatic world-wide telex network has been agreed by the CCITT (the International Consultative Committee for Telegraphs and Telephones). The Post Office has played a prominent part in the development of this plan. It is now tackling the problems involved in implementing it.

One of these problems has been to find a convenient means of recording charges for inter-continental calls and this has been solved by the development of automatic ticketing equipment.

International telex subscriber dialling was introduced in 1961, when fully automatic service to eight European countries was opened. It has since been extended to six more countries. Service to the remaining European countries to which subscriber dialling is not yet possible and also to extra-European countries, is handled by the new telex cordless switchboard.

In the European fully automatic service, British subscribers are charged on the basis of elapsed time by means of pulse metering, similar to the system used for inland charging. There would be some advantage in using the same method of charging for inter-continental subscriber dialling, but pulse metering cannot be used where a minimum charge period is applied. It appears that most administrations will wish to retain a minimum charge period when they introduce fully automatic inter-continental working.

There are other difficulties in applying pulse metering to inter-continental subscriber dialling. High pulse rates are involved, and there is also the problem of charging on routes using error-corrected radio systems where the actual time taken for the transmission of a message over the radio path may be different from the time taken to transmit it from the calling teleprinter.

Automatic ticketing as compared with pulse metering affords greater flexibility in the method of charging and can be applied to all types of routes. It also gives a record of individual transactions for both subscribers' and international accounts, which can be processed "off line".

The rapid growth of the international telex service has put a heavy load on the telex cordless board. To give urgent relief, it was decided to introduce subscriber dialling to the United States in 1964, and to New Zealand, Canada and Australia in 1965. For this purpose, an interim type of automatic ticketing equipment was designed. This, in the main, uses existing standard items of equipment which were readily available and could be installed in time to meet these dates.

The equipment, which is installed at the International Exchange in Fleet Building, will record all inter-continental calls made by British subscribers. Each outgoing or both-way circuit to the countries concerned will have connected to it a page teleprinter and control unit.

The switching equipment ensures that the called subscriber's answer back is returned on effective calls, and this is recorded on the ticketing teleprinter. The answer back of the calling subscriber is then taken and recorded.

The printed signal "MOM" is used as a means of providing timing information. This signal, generated accurately at six-second intervals, is readily available from existing equipment. The duration of the call is recorded by the printing of "MOM" at six-second intervals and beginning at random, "line feed/carriage return" will be injected at one-minute intervals.

By allowing one-tenth of a minute for each "MOM" in the first and last line, plus one minute for each intermediate row of "MOMs", elapsed time can be assessed to within one-tenth of a minute. The time of day will be recorded manually in the margin at half-hourly intervals by operators

An operator counts the "MOM" signals to assess the chargeable time. The signal is generated every six seconds.

Operators patrol the machines every half hour and insert the time of day in the page margins.

patrolling to see the printers are working satisfactorily.

Since billing is done by the Area Telephone Manager, details of calls will be transferred from the teleprinter record to similar type tickets as those used for switchboard calls and will be sent to the Area Office.

The control unit provides facilities for sending a test message to check the operation of the ticket printer. It includes pilot lamps to indicate when the ticket printer is in use or has been taken out of service. Spare machines will be available for patching into circuit to minimise lost circuit time.

To enable this equipment to be ready for service at the earliest possible moment, it was necessary to accept limitations in the facilities. For instance, having one teleprinter for each circuit makes it desirable to limit the number of circuits carrying outgoing calls.

Because of this limitation, unidirectional working has been introduced on the routes to the United States. When this method of recording is used for New Zealand and Australian traffic, it will be unnecessary to have unidirectional working. The time differences between peak traffic at each end of these routes is such that the number of outgoing only circuits required would be only marginally less than the both-way requirements.

Another limitation is that the calling subscriber's answer back has to be converted manually into number form for billing purposes. Most of the calls come from regular users of the inter-continental service who are a small proportion of all telex subscribers. The clerks who prepare the tickets will be given a list of the regular users and will only need to refer to the Directory for a small number of calls.

The rapid development of inter-continental telex service, and the desirability of automation, has made it necessary to consider the economics of world-wide telex traffic routing under fully automatic conditions.

The time difference between terminal countries in inter-continental relations and the consequent difference in the hours of peak traffic loading, may make it more economic to use tandem transit routing to a much greater extent than is practicable in continental networks.

The design of a comprehensive plan depends, among other things, on the standardisation of a signalling system for the transit network, and the introduction of uniform routing codes.

These problems have been under consideration by the CCITT for some time, and a greal deal of progress has been made. At the Plenary Assembly of the CCITT in June, 1964, a new signalling system developed by the British Post Office, known as Type C signalling, was accepted as the new standard for fully automatic inter-continental transit working. A list of telex destination (routing) codes for each country in the world was also agreed.

The basis has therefore been laid for the introduction of fully automatic inter-continental transit service. It is hoped that switching and signalling equipment for this will be available in Britain by early 1967.

The development of a new type of automatic ticketing equipment with improved facilities has been proceeding separately and will be compatible with the new switching equipment. This, for convenience is referred to as "permanent ticketing equipment" to distinguish it from the interim type and should be ready for service by early 1967.

With this equipment ticket printers will be provided in a common pool and brought into use only for the time needed to record accounting information. The number of printers required will be considerably reduced as compared with the interim scheme where a ticket printer is permanently connected to each circuit.

The information recorded will consist of a series of entries referring to either the beginning or ending of a call. These entries are known as "head" or "tail" sequences and include reference codes which enable the "head" and "tail" sequences for each call to be associated. In addition to the answer back of the calling subscriber the entries will provide details of the time the call is made, the destination and routing of the call, and the duration in tenths of a minute. Facilities will be available for the duration to be recorded on the calling subscriber's teleprinter if required.

The ticket printer will produce a perforated tape

OVER

HOW ETE HELPED IN

BRINGING THE NEWS FROM TOKYO

By A. K. WALKER

ON 10 October, at 05.00 GMT—2 p.m. Japan time — a youth born in Hiroshima the day the first atom bomb fell, lapped the track in Tokyo's giant National Stadium carrying aloft the Olympic Torch. There to report the scene and the events which followed were hundreds of overseas press correspondents and radio and television commentators. The burden of handling the huge volume of overseas traffic fell on the Kokusai Denshin Denwa Company (KDD)—the Japanese ETE.

When it was decided eight years ago to hold the 1964 Games in Tokyo KDD must have been very worried. Japan was then entirely dependent on radio for overseas communications and 1964 was expected to be a time of low sunspot activity when radio propagation conditions would be at their worst. Shortly afterwards, however, the first Trans-Atlantic Cable (TAT-1) came into service and its success altered the whole approach to inter-continental communications.

New cables laid between the American mainland and Hawaii in 1957, across the Atlantic between Britain and Canada, in 1961, and from Canada to New Zealand and Australia via Hawaii, in 1963, transformed the situation and it needed only a cable from Hawaii to Japan for cable connection to be available from Japan to Australasia, North America and Europe. This Trans-Pacific Cable (TPC) was completed in June, 1964.

The first cable telephone circuit between the international exchanges in London and Tokyo was connected on 13 July and a few days later the first London-Tokyo VF telegraph system was successfully opened. Over the past few years demands for UK-Japan telex and leased telegraph circuits had grown enormously and the radio techniques, including the use of a radio relay at Aden which resulted in a longer daily working schedule, had been improved. It was mutually agreed that these radio telegraph circuits would remain in service at least for the period of the Games, to supplement the cable circuits and to act as a standby in case of cable failure.

It is usually necessary at special events for the

TELEX *(Contd.)*

record as well as a printed record. The printed information could be processed manually, but it is planned to introduce a fully mechanised system for preparing telex accounts by feeding the perforated tape into a computer.

It is only four years since the Inland Telex service was converted to automatic working but development has been so rapid that already more than 90 per cent of all international calls originated in Britain are dialled by subscribers. The introduction of telex subscriber dialling to the United States—the first fully automatic service from Britain to another continent—is a significant advance.

The extension of fully automatic inter-continental working depends to some extent on the provision of more inter-continental circuits with stable transmission conditions which have already become available between some continents by the provision of modern submarine cables.

The progress of satellite communication gives promise of a significant increase in the number of stable inter-continental circuits and may well hasten the day when world-wide telex subscriber dialling is practicable.

THE AUTHOR

MR. S. R. V. PARAMOR joined the Engineering Department in 1928 and served in the Engineer-in-Chief's Office and a Regional Engineering Branch before transferring to the Telecommunications side where he served in an Area Regional Telecommunications Branch and the Inland Telecommunications Department. From 1956 to 1962 he was seconded to the Ministry of Communications, Nigeria, as Telecommunications Controller and later as Controller of Telecommunications. On his return to the Post Office in 1963 he was appointed Chief Telecommunications Superintendent in the Telegraph Planning Division of the External Telecommunications Executive.

communications authorities to make extensive arrangements for the rapid collection and despatch of reporters' copy by way of the public message service in order to meet newspaper "deadlines". But with an eight-hour time difference between Japan and Europe speed for this traffic was of less consequence. Daily newspaper correspondents had plenty of time to prepare their reports, put them into five-unit tape and transmit them by telex. ETE had been able to encourage the use of telex on a large scale for the first time (and thus ease KDD's and ETE's operating commitment) because for a story of 75 words or more it was cheaper than the message service. ETE arranged with KDD for telex lines to be installed on behalf of some British newspapers in hotel rooms, newspaper offices, and so on; other correspondents used the telex call offices at the stadia.

Not all the British press used telex, however. Reuters Ltd. supply news from overseas not only to the British press but also, through other facilities rented from ETE, to all corners of the world. Rapid communication is their lifeblood and for this reason they leased a telegraph circuit between London and Tokyo. For similar reasons the *Evening News* and *Evening Standard* also rented telegraph circuits and their Late Extra editions carried nearly all the results and descriptions of the day's events.

ETE was also asked by the administrations concerned to lease telegraph circuits from Tokyo to Stockholm (two), Helsinki, Warsaw and Budapest through London. All the leased circuits, plus seven new telex circuits and another public message circuit to strengthen the London service, were routed on the new London-Tokyo VF telegraph system.

For various reasons, the maximum number of TPC voice circuits which could be inter-connected with COMPAC was 12. Of these two were already in use to London (one for telephone and one for the telegraph system) and two were in use for the Canada-Japan telephone service. There was a shortage of trans-Atlantic circuits but a decision had recently been taken in conjunction with ETE's Commonwealth partners to convert the two 12 by 4 kc/s telephone groups feeding COMPAC to 16 by 3 kc/s working in order to meet normal growth. This provided the eight extra circuits required and the conversion was completed just in time.

Two of these eight voice circuits were reserved for leased picture circuits, one terminating in London (Associated Press) and the other extended to Stockholm (the European Picture Union terminal). When the European Broadcasting Union considered the bids from its members it was found that the peak demand was far higher than could be met by the remaining six circuits. Rather than attempt to adjudicate between the demands of the national organisations, the problem was resolved in conjunction with KDD by offering a full-time leased circuit for the exclusive use of the BBC and four circuits to the EBU, leaving them to exploit the circuits themselves. This they did by making four European terminals (Brussels, Hamburg, Hilversum, and Paris) responsible on a geographical/language basis. This left one circuit for occasional picture and programme transmissions not catered for by the leased circuits.

Television coverage was achieved by the use of the satellite *Syncom C* to relay pictures to North America. They were recorded at Montreal, flown to the Hamburg Eurovision terminal and fed out to the various television authorities, including BBC and ITV, over the Eurovision network.

Everything got off to a good start, but, unfortunately, on 15 October, TPC failed eight miles east of Guam.

The European telegraph leases were restored on the UK-Japan radio telegraph route, while those terminated in London were routed either by cable to San Francisco or Sydney and thence radio to Japan. The Sydney route was also used for the AP and BBC voice circuits on a part-time basis. This meant that the television commentaries which had been recorded by the BBC over the cable circuit had to be dropped.

The European programmes and picture transmissions—no doubt curtailed—were carried on direct radio circuits. Fortunately, the AT & T Co. cable ship *Long Lines* was in Okinawa and she succeeded in repairing the cable on 21 October.

The dissemination of news from the 1964 Olympics was a thoroughly successful operation. ETE was, of course, greatly helped by the fact that Japan is eight hours ahead (in summer time) of Britain, but the 1968 Games are to be held in Mexico which is seven hours behind GMT. This means that events will be taking place right up to the press "deadlines" for the STOP PRESS. Speedy movement of traffic will, therefore, be the primary aim and the problem this will pose will be an entirely different one from that of the Tokyo Games of 1964.

THE AUTHOR: MR. A. K. WALKER, MBE, joined the Post Office in 1939 as an Assistant Traffic Superintendent in the Bradford Telephone Area and served in the Royal Signals throughout the War. He returned to the Post Office in 1946 to Aberdeen telephone area. In 1951 he was promoted to Senior Telecommunications Superintendent. Since the end of 1956 Mr. Walker has been in the Operations Division of the External Telecommunications Executive. He is now Chief Telecommunications Superintendent in charge of the international telephone and telegraph circuit provision and customer services section.

In this third article in our series on interesting telephone areas and exchanges the author relates the 85-year-old story of the growth of the telephone system in Birmingham from the days when the first exchange there had only one switchboard and one boy operator

BIRMINGHAM:

IT ALL BEGAN WITH A DOZEN SUBSCRIBERS

By J. W. WHISTON

BIRMINGHAM Central Telephone Exchange is built on a sandstone ridge and its site has changed from south to north with the movement of commercial interests. At the top of the ridge is Birmingham Cathedral (St. Philip's) which has been the point from which telephone call charges for Birmingham have been measured since the recommendations of the Murray Committee were implemented in 1921.

The first telephone exchange in Birmingham was opened on the south side of the ridge in December, 1879, by the Midland Telephone Exchange Company in a small room in Exchange Chambers which took its name from the Iron and

***Right:* Exchange Buildings where the first telephone exchange in Birmingham was housed in one small room between 1879-1882. The switchboard had only one connecting panel and operating table. Picture: Courtesy Birmingham Reference Library.**

Steel Exchange. The switchboard was similar to that in Britain's first telephone exchange in Coleman Street, London—opened a few months earlier—except that there was only one connecting panel and one operating table, operated by a boy.

The exchange opened with about 12 subscribers. These were given service without charge for a period of three months with the option to

Telephone House where Central Exchange moved in 1938. Today the Central Exchange Area has more than 20,000 stations and traffic is still growing rapidly. Picture: Courtesy of Birmingham Post Studios.

continue at a yearly rental of £10 instead of the standard rate of £20.

In 1882 the exchange moved to the top of the ridge to a site at the corner of Bennetts Hill and Colmore Row, now occupied by Martins Bank. It was on the top floor of the building which belonged to a well-known firm of music dealers, Harrison & Harrison, close to St. Philip's Cathedral. The exchange was a small board of the Blakey-Emmott type. It probably never had more than four operators; and about 1889, girls had replaced boys who were the original operators.

Demand for service was brisk and the Company decided to open an exchange for jewellers in the northern part of Central Exchange Area which became known as Jewellers Exchange. This was opened (on the top floor of 26 Frederick Street) in October, 1880, and had 81 subscribers. These premises are now occupied by Arthur E. Heckford Ltd., Wire Manufacturers. It was staffed by caretaker-operators—Mr. and Mrs. Hopkins. They were assisted by their daughter who later became a Post Office supervisor. She is now living in retirement.

At one time the jewellers in this area had their workshops in their homes. As they prospered, they moved out to the suburbs, and their living-rooms were converted into more workshops—several firms often occupying one house. Because the

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BIRMINGHAM (*Contd.*)
jewellers only wanted to make telephone calls to other firms in the Jewellery Quarter they were given telephone service at a preferential rate of £10 a year.

The telephone service continued to grow. By 1886, in addition to the exchanges at Bennetts Hill and Frederick Street there were exchanges at Aston, Edgbaston, Moseley, Smethwick, and West Bromwich. There were 441 subscribers and five call offices listed in the 1886 telephone directory which was the first one issued in book form. (Incidentally, the first telephone directory issued in 1880 gave a list of subscribers' names without any numbers and subscribers were asked for by name. All subscribers' numbers were in a common numbering range and, except for Jewellers, were known as Birmingham Exchange. The exchange at Bennetts Hill was known as Central to distinguish it from the other exchanges.)

In May, 1888, the switchboard at Bennetts Hill was changed to a multiple switchboard of three 200-line sections. Trunk calls, which would have included calls to all exchanges outside the city, were dealt with by two wall instruments but later a small trunk switchboard was installed in a separate room. In 1885, there were only three junction circuits but the number soon increased. Access between Coventry and Birmingham was opened with a municipal ceremony in June, 1889, and on 10 July, 1890, the first important trunk route in the country was brought into service between London and Birmingham. This route involved the erection of 130 miles of 150 lb overhead wire. Two circuits were terminated at Birmingham and the route was extended by one circuit to Liverpool and one to Manchester. Central has always been an important trunk switching exchange and at the present time long distance traffic coming into Birmingham is routed via Central Exchange equipment and its local junction network.

A Birmingham lineman in the early days of telegraphy (about 1860). He used his top hat to carry his tools.

The number of subscribers was growing rapidly and the National Telephone Company, which had taken over the service in about 1883, erected in 1896 a new exchange building on the north side of the sandstone ridge at 19 Newhall Street. This was regarded as a most ambitious scheme and when it was opened in 1897 by Mr. Alfred Coleman, General Manager, he said the Company had a building which would last them for ever. This statement was understandable at the time as the Company were only using a part of the building, the ground floor being let to a number of private firms, auctioneers, insurance companies and so on. The existing entrances on the ground floor show that it was designed for sub-letting. The building is still in use and is well known to Post Office staff in Birmingham.

It is a remarkable building, most ornate in design with pinnacles, urns, shields, false gargoyles and balconies, on the balustrades of which lie recumbent animals. It was built in terra-cotta brick, as were several other buildings in Birmingham at that time, as a protection against erosion and darkening by city smoke. The present state of the buildings shows how effective this type of brick is against attacks of a polluted atmosphere.

The switchboard at 19 Newhall Street was, of course, the magneto type as were the earlier switchboards, but in July, 1907, a CB switchboard was installed and for many years magneto and CB switchboards worked side by side. In 1909 Jewellers Exchange was transferred to 19 Newhall Street where the lines worked on a separate group of positions using an early type equipment

Under the fascinated gaze of a group of young spectators a cable-laying team of 1895 puts in new cables at Colmore Row outside the Central Exchange. Picture: Courtesy Birmingham Reference Library.

which included a combined indicator and jack, still remembered by some of the retired engineers because it was so difficult to maintain. Jewellers continued as a separate exchange until about 1913 when it was absorbed into Central, shortly after the National Telephone Company was taken over by the Post Office.

During the First World War, 19 Newhall Street was used by the military as the Midland Headquarters of the air raid warning system. When the first zeppelin raid occurred on 31 January, 1916, Birmingham escaped but there were strong representations from the Midlands, led by the Lord Mayor of Birmingham, Neville Chamberlain, for the control of lights and for an early warning system. As a result the Government set up a scheme of sending warning messages by telephone exchanges. Birmingham suffered little damage

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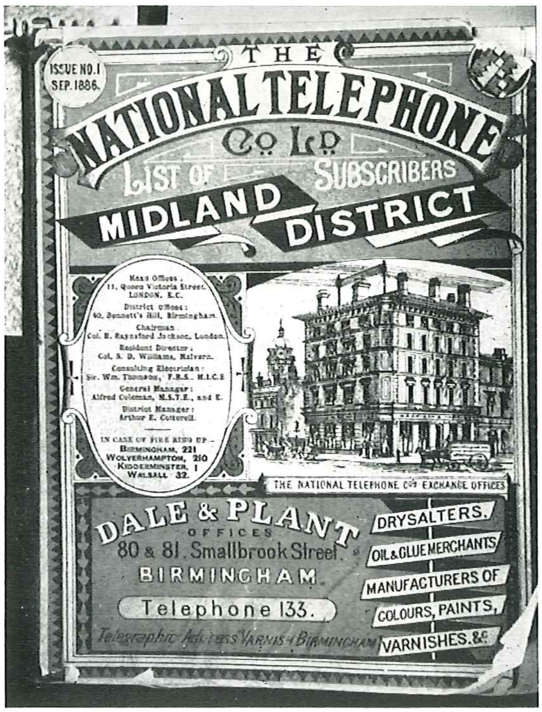
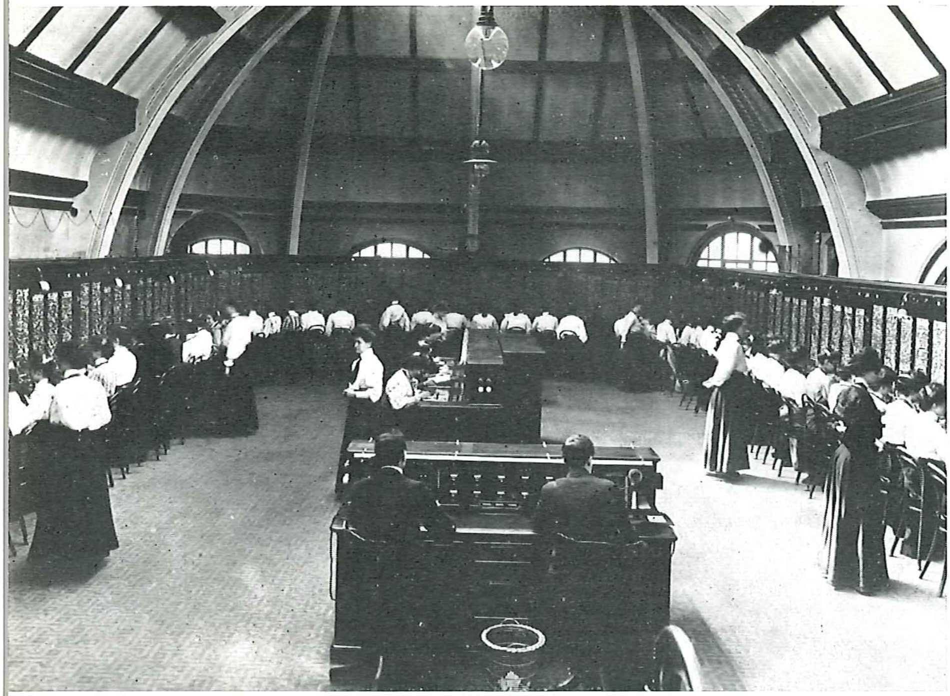


The ornate cover to the 1886 Birmingham telephone directory, probably the first in the country to be issued in book form. It listed just over 400 subscribers and five call offices. Picture: Courtesy J. W. Whiston.



Left: The manual switchroom at the Central Exchange (then in Newhall Street) in 1908. This building is still used by the Post Office.

from raids. This was due to the advance warnings received and distributed from 19 Newhall Street.

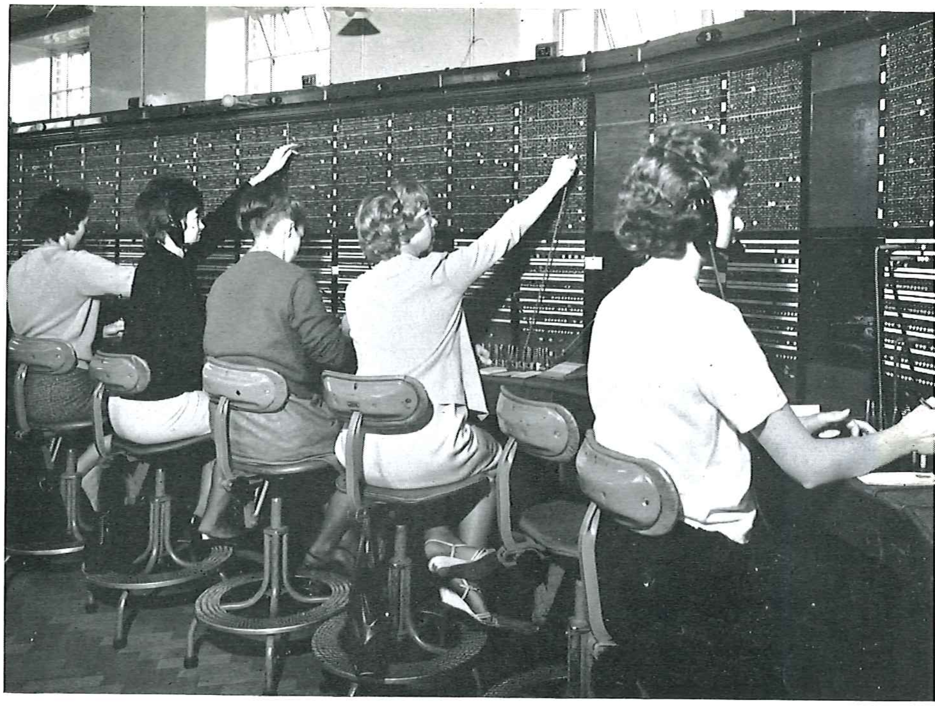
Central Exchange was the parent for most of the exchanges in Birmingham, and as the number of subscribers grew they were hived off to separate exchanges. Some exchanges started with their own names as hypothetical exchanges on Central until they were large enough to stand on their own feet and continue as separate exchanges. Aston Cross was one of these, and another was Colmore, a short-lived offspring which after being hypothetical on the manual and automatic exchanges was closed on 3 September, 1956. By 1908 there were 5,000 subscribers on Central and 160 operators. Relief was given by a new exchange—Midland, opened on 14 November, 1908, in a new building in Hill Street. As Central continued to grow, more lines were transferred to Midland in May, 1929, and again in November, 1930.

By the mid-1930s the traffic carried by Central exchange was very heavy. This was the period when manual exchange working had reached its heyday. Over a number of years, manual operating procedure had by constant refinement reached the peak of efficiency as a means of dealing with large quantities of calls, a high proportion of which

THE SIGNIFICANCE OF THE SANDSTONE RIDGE

Until the recent development of the centre of Birmingham many of its citizens did not realise that the city was built around a ridge of sandstone—Keuper sandstone to the geologists. The ridge, along the line of Colmore Row and Steelhouse Lane, has long been hidden by buildings of the Victorian and later periods and their replacement by modern, widely-spaced clinical-looking buildings has revealed and emphasised the height of the ridge. The sandstone was one of the main reasons for Birmingham's existence and the source of its first industrial power. The city has a plentiful supply of good water, sufficient in early times to support a large population and to give the power for the early workshops which grew up on its south side. As trade expanded the town grew to the top of the ridge and over to the north side. Here the water and ample deposits of sand suitable for casting, attracted the tradesmen and small workshops which grew into the Birmingham Jewellery Quarter, which handles a larger quantity of jewellery than any other part of the country.

Right: The Four Oaks manual exchange, 1964. In the picture are Mrs. A. Hill, Miss R. Shelley, Miss M. Nettleingham, Mrs. W. White and Miss H. Baker.



were local calls. The load carried by Central Exchange operators at this time was very high and at no other time or place has the skill and dexterity of operators been exceeded or have engineers worked so hard to maintain an old exchange.

By 1938 Central could grow no more and on 19 March, 1938, it was converted to automatic working, the equipment being installed by Siemens of Woolwich in a new modern building—Telephone House. This was lower down on the north side of the sandstone ridge, and it was ceremonially opened by the Rt. Hon. Neville Chamberlain, then Chancellor of the Exchequer.

The old building at 19 Newhall Street has been put to many uses since Central Exchange moved to Telephone House. It has been the Midland Region Headquarters, the Regional Wing Training Centre, and has housed the Area Traffic Division. At present, the telegraph automatic switching equipment and some VF telegraph equipment are installed there. Other parts of the building are used for the Circuit Provision Group, a Recruitment Centre and for regional training courses for exchange supervisors and enquiry operators.

Today, the number of subscribers in the Birmingham Central Exchange area has almost reached saturation point, with over 6,000 lines and 20,000 stations, but the traffic still grows very rapidly. The number of calls made by Central subscribers is about 100,000 a day. It serves the

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Technician Mr. Robert Henson adjusts group selectors at the Central Exchange which has been housed in Telephone House for 26 years.

The incoming and inquiry positions on the switchboard in Telephone House today.

BIRMINGHAM *(Concluded)*

most important part of the commercial interests of Birmingham, the City Corporation, the City Police, the largest bank and insurance offices. It used to serve the medical specialists in Edmund Street which was the "Harley Street" of Birmingham. These have now moved out to the Edgbaston area but some of the older hospitals and associated organisations remain. A large part of the Jewellery Quarter is still served by Central, the remainder being in the Northern Exchange Area. Associated with the jewellery trade are the many small firms which make all the small unusual metal artifacts which are required by the trade. The district is almost entirely a commercial and professional area and the academic and cultural world has few representatives save the City Art Gallery and Museum and the Birmingham Library, an old-established subscription library, but there are two cathedrals, St. Philip's and St. Chad's (Roman Catholic) and a convent.

Central Exchange subscribers have had Subscriber Trunk Dialling since July, 1961, and on 14 September last International Subscriber Dialling facilities were provided to France, Western Germany, The Netherlands and Switzerland. During its life at Exchange Chambers, Bennetts Hill, 19 Newhall Street and Telephone House, it has, like many other large exchanges, grown continuously, carried increasing amounts of traffic and served the commercial world without fuss or major catastrophies. Many generations of Post Office men and women have come to Central Exchange to make their contribution. They have moved on to use their experience elsewhere; to marry and bring up families, many of whom have come back in their turn to make their contribution to the exchange and the Birmingham business community.

All exchanges in the Birmingham area are now automatic. Central Exchange has been the parent to most other exchanges and has seen its offspring grow until some rival it in size and importance. In a few years it can expect a new offspring—an exchange called "Snow Hill.

THE AUTHOR

Mr. J. W. WHISTON, Chief Telecommunications Superintendent, Birmingham, is employed on equipment and planning work.

He entered the Post Office in 1931 as a Youth in Training and in 1936 was promoted Assistant Traffic Superintendent. Five years later as Assistant Inspector of Telephone and Telegraph Traffic Class II, he worked at GPO Headquarters and in 1949 was promoted to Assistant Telecommunications Controller Class II, Midland Region, before taking up his present post.

Telecommunications Statistics

	Quarter ended 30 June, 1964	*Quarter ended 31 March, 1964*	*Quarter ended 30 June, 1963*
Telegraph Service			
Inland telegrams (including Press, Railway Pass, Service and Irish Republic)	**2,757,000**	2,628,000	2,954,000
Greetings telegrams	**635,000**	617,000	615,000
Overseas telegrams:			
Originating U.K. messages	**1,657,000**	1,599,000	1,560,000
Terminating U.K. messages	**1,690,000**	1,637,000	1,573,000
Transit messages	**1,255,000**	1,284,000	1,239,000
Telephone Service			
Inland			
Gross demand	**181,000**	188,000	140,000
Connections supplied	**162,000**	160,000	117,000
Outstanding applications	**167,000**	171,000	167,000
Total working connections	**5,709,000**	5,620,000	5,402,000
Shared service connections (Bus./Res.) ...	**1,124,000**	1,113,000	1,097,000
Effective inland trunk calls	**174,695,000**	160,696,000	148,519,000
Effective cheap rate trunk calls	**38,665,000**	34,054,000	33,909,000
Overseas			
European: Outward	**1,366,000**	1,205,000	1,140,000
Inward	***1,078,000**	1,061,000	*1,010,000
Transit	**12,000**	*12,000	11,000
Extra European: Outward	**123,000**	114,000	94,000
Inward	***148,000**	*140,000	115,000
Transit	***21,000**	*19,000	17,000
Telex Service			
Inland			
Total working lines	**13,000**	12,000	11,000
Metered units (including Service)	**38,644,000**	36,242,000	29,777,000
Manual calls (including Service and Irish Republic)	**42,000**	38,000	39,000
Overseas			
Originating (U.K. and Irish Republic) ...	**2,111,000**	1,993,000	1,641,000

Figures rounded to nearest thousand. *Includes estimated element.

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POST OFFICE TELECOMMUNICATIONS JOURNAL

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SPRING 1964—WINTER 1964

ALPHABETICAL INDEX

GROUP INDEX

Marconi Self-Tuning H.F System
–the first in the world to be station
planned from input to output.

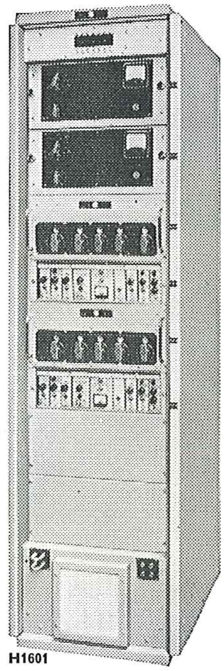
MST breakthrough

MST drive systems for h.f transmitters

MST drive systems meet all CCIR Recommendations

H1601

Comprehensive synthesizer drive assembly for two independent transmitter channels
Inputs: audio frequencies (6 kc/s bandwidth) or d.c
Outputs: modulated signals at radiated frequencies, 2 W p.e.p
Types of modulation: i.s.b with floating carrier, pilot carrier or fully suppressed carrier; d.s.b; c.w 400 bauds; f.s.k 200 bauds or 3,500 bauds; frequency shift diplex
Frequency range: 2—27,9999 Mc/s
Frequency selection by decade dials on frequency synthesizers
Stability: determined by 1 Mc/s master frequency



H1601

H1605

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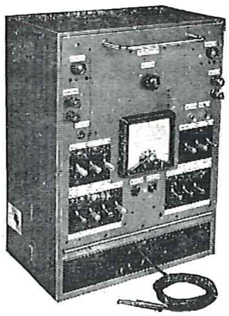

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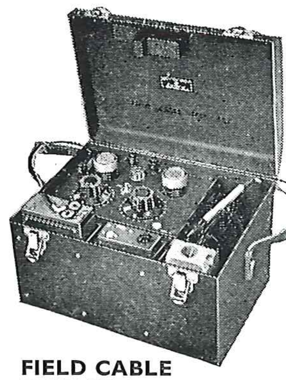

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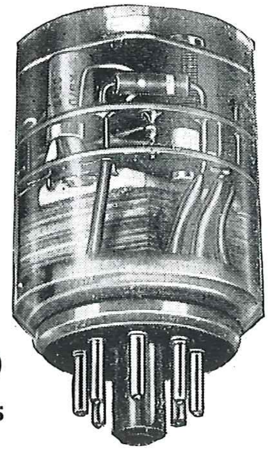

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